

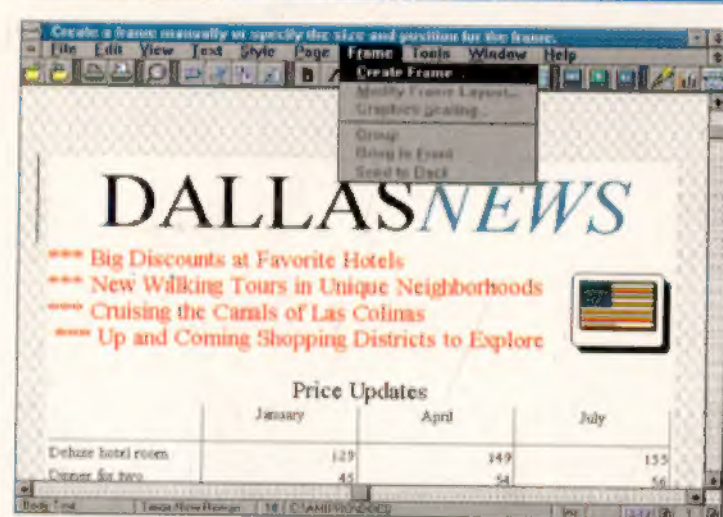
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Seven SQL Databases That Bring Client/Server Power to PCs

Integrated Software: Seven Packages Do It All—for Less



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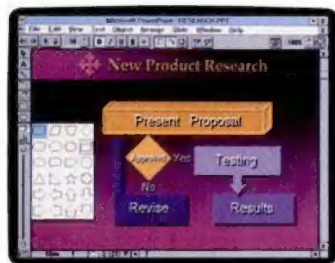
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Mary Sue Will You M

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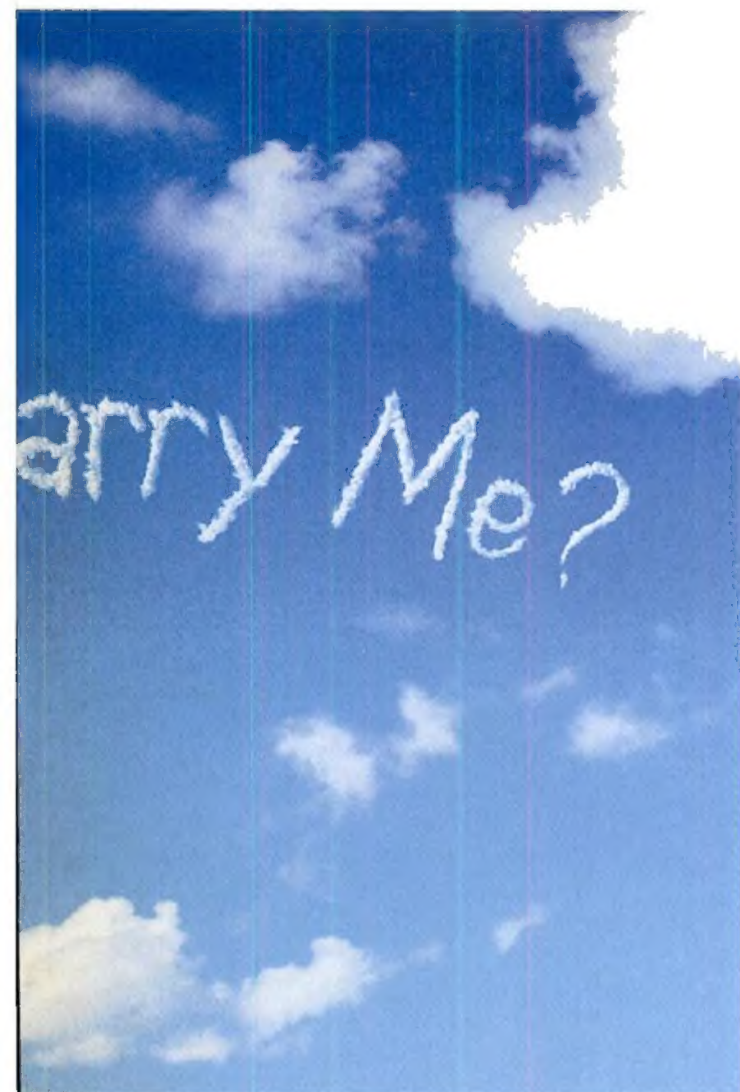
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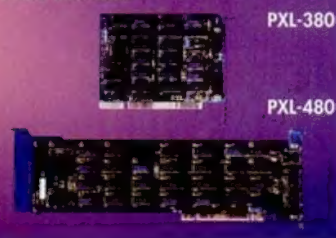
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Inside

How much power can you afford? The pursuit of speed and muscle by PC buyers sometimes reminds us of auto buyers before the 1970s' oil crises. We want bigger motors, taller tail fins, throatier exhausts, even if we only drive down to the super-

market—or, in a computing analogy, run WordPerfect and 1-2-3.

The important difference between the muscle cars and PCs is that computers keep getting cheaper. In one recent seven-day period, the average prices of PCs from top vendors dropped 13 percent as Compaq entered the market with its low-cost machines and the big direct-mail manufacturers jockeyed for position. The answer to our question about affordability seems to be: What week is this?

In this issue's cover story, our PCs team reviews 63 486DX2/50 computers. The DX2 chip effectively doubles the speed of a 486SX chip—something akin to dropping a bigger V8 into your engine compartment.

The convergence of power and lower prices couldn't be better-timed. The transition from text-based computing to graphical operating environments, such as Windows, OS/2, and soon Windows NT, keeps lifting the standard for the minimum machine you need. With prices falling so fast, the Ferraris become more affordable and power becomes far less of an issue.

SQL databases, probably the

most secure and robust databases available, originated on mainframes and minicomputers. As companies have moved important applications to PCs, the SQL vendors have also followed that



ILLUSTRATION BY VICTORIA KAHN

migration. The response to our announcement that we would review SQL servers and front ends was a collective sneer by SQL vendors: There was no way a personal computer magazine could understand client/server databases—or test them fairly.

Over a period of months, we convinced most of the major players that we could indeed handle the complex technologies involved. Our review of SQL servers in this issue, "SQL Databases: High-Powered, High-Priced," is as much the result of diplomacy as of technical expertise. In our next issue, we'll tackle SQL front ends.—*Joel Dreyfuss*

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Sales	\$14,624	\$48,549	\$24,777	\$87,950
COGS	\$13,671	\$24,314	\$16,544	\$54,529
SG&A	\$1,462	\$4,855	\$2,478	\$8,795
Total Cost	\$15,134	\$29,168	\$19,022	\$63,324
Profits	(\$509)	\$19,381	\$5,755	\$24,627

Variance Report by Product Eastern Region -- 1989			
	Actual	Plan	Variance
LPs	19,499	21,344	(1,845)
Units	\$0.75	\$0.75	\$0.00
Price	\$14,624	\$16,000	(\$1,384)
Sales	\$13,671	\$13,058	\$613
Cost of Goods Sold	\$1,462	\$1,921	(\$459)
Selling & Admin.	\$15,134	\$14,979	\$155
Total Cost	(\$509)	\$1,029	(\$1,539)
Profits			

Eastern Forecast - Pdt A				
	1989	1990	1991	1992
% Sales	100.00%	100.00%	100.00%	100.00%
Sales	81.57%	79.63%	77.77%	75.91%
COGS	12.00%	12.00%	12.00%	12.00%
SG&A	93.57%	91.63%	89.77%	87.91%
Total Cost	6.43%	8.37%	10.23%	12.09%
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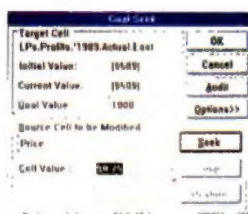
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Computers

Intel Ups the Ante with Its 50-MHz DX2

BY BILL HOWARD They're almost as speedy as true 50-MHz 486DXs, yet most cost less than \$3,000.

PC Magazine Labs analyzes 63 units based on Intel's new speed-doubled DX2 chip. Is the end of the 386 at hand? 110



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Server-Monitoring Software:
Getting Inside Your File Server

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Low-Cost Integrated Software:
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BY TED STEVENSON Integrated software combines word processing, spreadsheets, and databases—and often graphics and communications, too—in one compact package. With the explosion of mass-market hardware sales and a huge movement to small business, escalating competition among integrated software vendors is pulling prices down. PC Magazine reviews seven low-cost integrated packages 311

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Connect a MIDI keyboard, synthesizer, and MIDI board for monitoring your playing while recording (page 439).

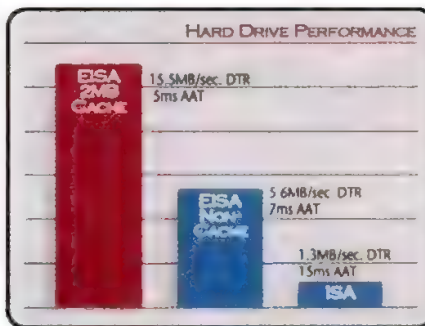
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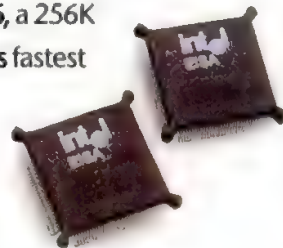
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Maxtor 340MB 12ms SCSI Hard Drive with 64K
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Intel 80486 Processor with 8K Cache & 487 Math
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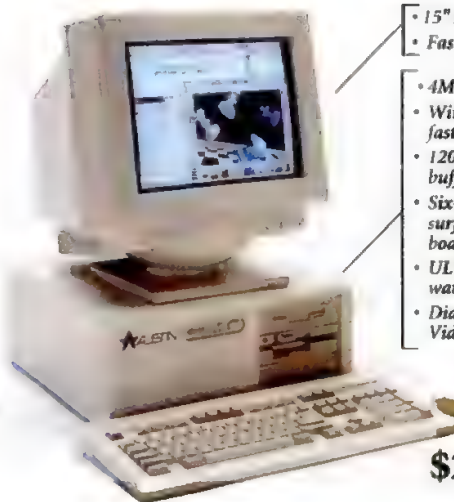
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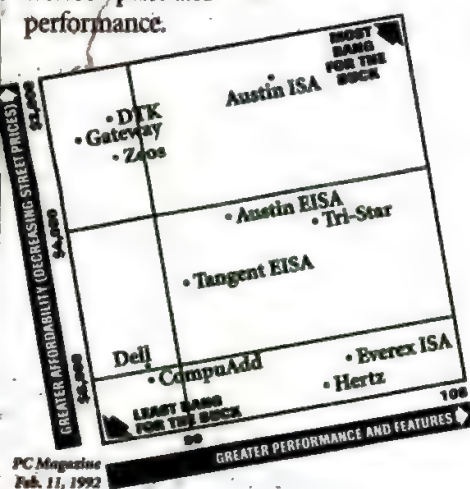
February 11, 1992
Austin 486/33 WinStation

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PC Magazine Contributing
Editor Winn L. Rosch

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The performance/features ratio of this chart is based on ten data points: the four benchmark test scores, installed RAM, disk capacity, VGA RAM, five slots, drive bays and extras (miscellaneous items such as first installed software, on-site service, FCC Class B certification, improved warranty policy and flash EEPROM). A set of weighting factors has been applied to the raw numbers; you can find this data in the Software Library of PC Magazine's Editorial Forum at USABC.WEL.

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Letters

WHAT? OS/2'S A WINNER?

I have just finished reading William F. Zachmann's column ("OS/2's a Winner!," June 30, 1992). I've had it! How many times have we *PC Magazine* readers had to endure Zachmann's unbridled enthusiasm for OS/2?

No matter how many bad versions of OS/2 IBM released, Zachmann was right there touting its superiority. If OS/2 were half as good as Zachmann would have us believe, it would already be the dominant operating system. He has never shown the least bit of objectivity. His zeal for this product is so great; how can anyone believe a word he says?

Paul Chandler
Irvine, California

William Zachmann's June 30 column was the most incredible piece of nonsense I've ever read. In the very same issue where Microsoft Windows 3.1 occupies the top two spots on your Top 15 Software Sellers at Retail list and OS/2 2.0 is nowhere to be found (three months after its release), he spews out one absurd claim after another.

Windows 3.1 is a very stable package, contrary to the misconceptions Zachmann attempts to convey. Not only has he lost all credibility, but it is hard to understand how that column ever made it into print.

Phil Rieke
San Diego, California

I kept looking for the word *advertisement* under William Zachmann's column, but it seems to have been inadvertently misplaced. I know columnists have more freedom with opinions than do regular journalists, but some semblance of reality is still generally expected.

The sad thing is that Zachmann has lost all credibility with his readers—even the OS/2 enthusiasts at our university laugh at him.

I suppose I've answered my original question. *Advertising* does not appear below his column because the truth-in-advertising laws would prevent it.

Robert R. Alexander, Ph.D.
Maryville, Tennessee



Once again we've managed to spark a civilized and unemotional debate.

"OS/2's a winner!" Not yet! Imagine my horror when OS/2 couldn't restore my data from my ArchiveXL 1.94 80/120 tape backup. IBM knew this was a problem and they never told me. "A better DOS than DOS"? NOT! I need to back up my system daily, and OS/2 can't do it. Maybe OS/2 2.1?

Dudley Smith
Ashburn, Virginia

I was pleased to read William Zachmann's column about the success of OS/2 to date. I'm relieved to find that the legacy of Jonathan Swift has not been lost and is alive and well in the pages of *PC Magazine*.

Now I can enter the new age of computing, 1992—the year OS/2 outsells every other operating system. Thanks to Zachmann for pointing this out to all of us who could not see because of all the dirty Windows we were looking out from.

Harvey Sweeney
Seattle, Washington

YES, OS/2'S A WINNER

William Zachmann is wrong! Windows 3.1 doesn't come crashing down often enough to be a pain in the neck! It crashes so often it's a pain in the ***! I will eventually be moving to OS/2.

This time, however, I'll play it smart. I won't run out right away and buy the program because of glowing reports in *PC Magazine*, as I did with Windows 3.1. Instead, I'll wait a few months and give the general public a chance to do a proper beta test. Zachmann deserves praise for sticking to his guns on this one. His prophetic skills have held true once again.

Dave Aultman
Granada Hills, California

I wish to thank William Zachmann for touting OS/2 and having enough vision to embrace the future now. OS/2 is a system that works, runs Windows and DOS, and does your laundry at the same time. Well, maybe it doesn't do the wash, but it sure cleans up on UAE problems. Much praise goes to IBM for giving me what they promised. William Zachmann, you kept the faith, you were right, and I thank you again for saving me from the "Reboot Blues."

John D. Lloyd
Stowe, Vermont

I'm sick of hearing about the "wonderful" improvements in Windows 3.1. Some improvements!

I've been running OS/2 2.0 for almost two months. It provides seamless desktop integration between our local NetWare network, our Xerox network, a statewide NetWare WAN, our 3090 mainframe, and our departmental AS/400. My machine has locked up exactly once.

The only parts of Windows 3.0 and 3.1 that are still on my desktop at home and at work are the pretty little .BMP files, which OS/2 scales nicely, thank you.

With the noted exception of William Zachmann, the rest of you, and Bill Gates, can go pound sand.

Dan Whitehouse
Frankfort, Kentucky

BIG MONITORS FOR WINDOWS

PC Magazine's cover story on large-screen monitors ("17-Inch Displays: A Better View of Windows," June 30, 1992), emphasizes the difficulty of maintaining image quality as the size of the CRT increases. Weren't the MAG MX

LETTERS

17F and Nanao Flexscan F550i Editors' Choice monitors, with visible screen sizes of 15.5 and 15.8 inches, respectively, inappropriately compared with monitors having the same size CRT but visible screen sizes up to 1 inch larger?

You also note that problems are most likely to occur 1 inch from the upper-left or lower-right corner. Was the MAG unit able to retain its image quality because it gave up trying to display the outer 1.5 inches of the CRT?

*Paul E. Szabo
Cleveland, Ohio*

I was totally astounded to read in Alfred Poor's discussion of new display technology that CRT's have a partial vacuum inside them. In point of fact, the vacuum inside a CRT is as near to perfect as technology can make it. This is true of all other vacuum tubes as well.

The reason for this is that the presence of any ionizable gas molecules in discernible quantities inside a vacuum tube will lead to malfunction at the very least, and in most cases, to prompt self-destruction.

I've worked with vacuum tubes for more than 50 years, but I realize that solid-state technology has been around long enough to produce technicians with little or no knowledge of vacuum-tube technology. It makes me feel unpleasantly old.

*Billy R. Pogue
Lake Havasu City, Arizona*

Your cover story missed an important "feature" of high-end monitors: their blackout period. There are a lot of software products that require frequent toggling between text and graphics modes. A little jerking when the monitor syncs to a new mode seems universal, but a long blackout delay is really annoying.

*Harley Flanders
Ann Arbor, Michigan*

BAD CONNECTION?

Your communications software review ("Modem Communications Software: Too Hard to Use?," June 30, 1992), had a performance test blunder. The criteria for the Zmodem Date Code are met

when the product's Zmodem determines whether or not the file being transferred is newer, and, if it is not, doesn't overwrite the existing newer file (of the same name).

Telx does not pass this narrowly defined test because it uses a different protection scheme, which changes one character in the file extension for duplicates regardless of protocol. If the test is important enough to be in the roundup, then I think that there should be an asterisk next to Telx or any other program that uses a duplicate protection scheme.

*Ravi Shah
Pittsburgh, Pennsylvania*

• In any product comparison, we always test as many features as we can, but we can't always look at everything. In this

*You missed an important
"feature." A little jerking
when a monitor syncs to a
new mode seems universal,
but a long blackout delay is
really annoying.*

case, we chose the protection scheme implemented in Zmodem because most people consider it to be a standard.—Ed.

I was extremely disappointed by your review of Telemate. You completely ignored many of the features that make this product unique, such as the presence of a command stack that will store a buffer of all outgoing text.

What bothered me most is that you never revealed that Telemate is a true multitasking program, complete with window resizing, moving, and zooming! It's an incredible program that serves my needs well without forcing me to enter the Windows environment. In short, I think you gave Telemate short shrift.

*Brian Thomas
Seattle, Washington*

HOW TO NETWORK AN AS/400

I just read "AS/400-to-PC Alternatives" (Connectivity, June 30, 1992). Ethernet

is fully supported by IBM, and the performance is as good as that of any high performance Ethernet adapter. A user should not use a NetWare router to connect an AS/400 with Token-Ring and a LAN with Ethernet. That's silly. Just buy the Ethernet card for the AS/400. It's easy, quick, inexpensive, and fully supported by IBM's PC Support software.

As to how to attach to the AS/400 economically, if you have more than a few PCs, use a LAN! It is cheaper and faster and gives you only one wire to the PC.

*David Hingst
Anchorage, Alaska*

"AS/400-to-PC Alternatives" was full of misinformation and showed a lack of knowledge about PC Support software.

PC Support will work under OS/2 and Windows 3.1; I use it under Windows 3.1. It doesn't have to take up a lot of RAM; you can load just the modules that you want to work with during the session.

PC Support works quite well and is reliable. To say that the PC side of it needs a total rewrite just reinforces your PC-opinionated bias.

*Keith Misegades
Elkin, North Carolina*

PUT ON A HAPPY INTERFACE

In his recent column ("Interface Relics," June 30, 1992), Jim Seymour asks if anyone can explain the logic in Windows' "standard" commands for cutting, copying, and pasting. Not only can I explain the logic in these key combinations, but I believe they make more sense than the "new" Macintosh-style commands.

First, the Shift key is used consistently in Windows to select text in combination with the direction keys. For cutting and pasting selected text, the Shift key is simply teamed up with the Del key and the Ins key. The Del key naturally suggests taking text out, and the Ins key, putting text in. This is completely logical.

*Bradley A. Grigor
Newmarket, Ontario, Canada*

Jim Seymour says in his June 30 column that one problem with the Windows interface is that Windows' font lists do not scroll. I actually prefer the lists the way they are because it gives me the ability to see what font I am working with. Aren't there any other problems with

All I really wanted to do
was simplify my job.

So I bought Windows. I

added extra RAM. I bought a

bigger hard disk. I replaced
my video card and monitor.

I bought a half-dozen new
programs, installed a mouse,

configured the system, and

as I sit here watching my

spreadsheet crawl on my PC,

I'm thinking to myself,

"This is making
it easier?"

Then there's Macintosh. The only personal computer designed from the very first chip to work the way people work. That's why Peter Lewis of *The New York Times* wrote the Macintosh is simply "better than DOS or Windows." That's why *Byte* wrote, "If you use a GUI to keep your computing tasks sorted out, the Mac does it best..." That's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* There's no personal computer on earth quite like it. And none more imitated. The affordable, compatible, connectable Macintosh personal computer. The power to be your best.®

Macintosh from Apple.



*J.D. Power and Associates' 1991 Computer End User Satisfaction Study™ Phase II: Business End User Summary. Responses from 5,811 end users at 4,396 business sites. Peter Lewis quote from October 29, 1991, edition of The New York Times. © 1992 by The New York Times Company. Reprinted by permission. Byte quote from March 1992 issue. © 1992 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, Mac, Macintosh and "The power to be your best" are registered trademarks of Apple Computer, Inc. Windows is a trademark of Microsoft Corporation.

LETTERS

Microsoft Windows that are more deserving of his attention?

Jeremy Krinitt
Rancho Palos Verdes, California

FUTURE SHOCK

PC Magazine has chided other publications that covered "vaporware," but your recent coverage of NT leads me to believe that you've begun to do the same.

With NT just a glimmer in Bill Gates's eye, you gave it coverage as the next major breakthrough in "gotta have" software. Meanwhile, OS/2, a shipping product, got medium coverage along with a side mention praising NT. NT is perhaps in beta (more likely alpha) testing.

It seems to me that *PC Magazine* is not so independent as the banner on the cover of each issue proclaims.

Paul Flatt
Ridgefield, Washington

DON'T IGNORE DR DOS...

DR DOS is often included in your Top 15 Software Sellers at Retail list and is certainly spoken of as a far better DOS than MS-DOS. It remains, however, tremendously neglected by *PC Magazine*. Ninety-nine percent of the time it seems that nothing but MS-DOS exists until there is a specific review of DR DOS when it has a new release.

Tom Barwick
Shelton, Washington

In response to Microsoft's cruel coding, Windows 3.1 and DR DOS 6.0 are incompatible. A little message about the MS-DOS extender popped up whenever I typed "win" at the prompt in DR DOS. Luckily, update disks came from Digital Research and solved all my problems.

Thanks to all the wonderful DR people, who probably had to wait until Windows 3.1 was out on the shelves before they could get their hands on the coding in order to solve the problem.

Chris Lindbergh
Kyle, Texas

... AND DON'T IGNORE GEOWORKS, EITHER

My PC came bundled with GeoWorks. I use Windows at work and I don't want

to bash it, but I do believe I've found an alternative. Never before has there been a more powerful, more user-friendly, more ready-to-go package available for PC users of every caliber.

As a GUI, GeoWorks just can't be beat. Your coverage of it has been a little lacking.

Charles Landers
Houston, Texas

TOO HARD ON HARD DRIVE

Your review of *Hard Drive* (Read Only, June 30, 1992) suggests that the biography of Bill Gates is a two-dimensional portrait that provides little insight into Gates's mind. I'd be curious to hear what you think his other dimensions are, since you didn't describe them in your review.

Gates has done at least as much to sup-

*There's no contradiction
between being high-tech
and being environmentally
aware. We all need to be
sensitive to the
environment.*

press innovation in the PC industry as he has done to promote it. He is a remarkably two-dimensional individual, lacking in human depth and uninterested in anything other than domination. I doubt that a portrait of his inner mind would yield anything of interest.

Frank W. Sudia
New York, New York

LET'S GET GREEN

I enjoy *PC Magazine* very much. There is, however, one thing that I don't like. *PC Magazine* is not recyclable. I would hope that the management of *PC Magazine* would consider using recycled paper and paper that could later be recycled, such as nonglossy paper. There is no contradiction between being high-tech and being environmentally aware. In order to keep the computer age going, we need to be to be sensitive to the environment.

James P. Melendez
Albuquerque, New Mexico

• **Currently, there is no recycled paper available that's the right type and quality for *PC Magazine*. We are, of course, monitoring developments in recyclable paper all the time.—Ed.**

RECONSIDER TYPECASE

I wish to express my strong disagreement with your review of Swfte's Typecase (First Looks, June 30, 1992). I'll grant that Typecase's screen fonts may not be as carefully wrought as Adobe's and Bitstream's, but the printed output is the criterion upon which any typeface package should be judged, and Typecase performs very well in this area.

Typecase is a superb value given that the printed text rivals its pricier competitors, and I, for one, am willing to put up with inferior screen text to get more than twice the typefaces at half the price.

Charles Lawson
Tallahassee, Florida

LEAPIN' LEAP YEARS!

Say it ain't so! In your June 30, 1992, *PC Magazine* Letters column, you state that the year 2000 is a leap year? I fear that many software and hardware manufacturers agree with you. How many system clocks will have to be reset and how many software workarounds will we have to do? Years evenly divisible by 400 are NOT leap years.

David Bergman
Silver Spring, Maryland

IF THIS IS TUESDAY, IT MUST BE PC MAG

I would like to know if *PC Magazine* has any sister publications in Europe.

Adam Bronikowski
Castro Valley, California

• **On your next trip to Europe, scan the newsstands for *PC Magazine* in Great Britain, *PC Professionell* in Germany, and *PC Expert* in France.**

NOVEL NOMENCLATURES

A modest proposal: Since most software reviews leave out the true costs of installing and learning a new program, I've defined the following units for use in reviewing software.

- **GOB:** a unit of memory required for running a program.
- **OODLE:** a unit of disk space required for installing a program.

I FEEL LIKE I'M BEING PECKED TO DEATH BY DUCKS.

At \$149.95 per PC, Windows
sounded like a deal. Then I bought
all new programs at about \$500
a pop. I shelled out a couple hundred
per machine for extra memory. I ponied up
\$300 each for networking cards. The
mouse ran \$100 and a bigger hard disk
ran \$275. And as I stare at the invoice
for what it's going to cost me to connect
them all together, I think to myself,

"THIS IS MAKING IT
EASIER?"

Then there's Macintosh. There are no hidden costs. There are no cards to buy for networking, file sharing, sound, video or peripheral support. That's why *Computer Shopper* magazine said, "Let's not be coy: If you want the best GUI money can buy, get a Macintosh." That's why *MacWeek* said, "Apple has shown that it can be technologically brilliant and price competitive at the same time." And that's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* There's no personal computer on earth quite like it. And none more imitated. The affordable, compatible, connectable Macintosh personal computer. The power to be your best.

Macintosh from Apple.



LETTERS

- EON: a unit of time required to learn a program.
- TON: a unit of mass for user manuals.

Units are normalized against Lotus 1-2-3, Version 1.0, which equals 1.0. Therefore, Windows 3.1 requires 8.2 gobs of memory and 10 oodles of hard disk space, takes 5 eons to learn, and comes with 2 tons of manuals.

*Patrick Sheehan
San Rafael, California*

LOOKING BACK INTO OUR FUTURE

I have just read John C. Dvorak's "The Platform Shift Is Now" (July 1992), and I think that he is essentially correct. For most users that will mean significant investments in new software, new hardware, and new training. It also means deciding on a new direction for your computing environment, whether it is corporate or personal.

It is not in the best interests of Microsoft and IBM to make people think in terms of platform shifts. Unlike the situation in 1981, if users think in terms of wholesale shifts and are willing to make the investments mentioned above, then Macintosh, NeXT, Sparc, and others all become viable alternatives for the corporate customer.

Perhaps everything in the future will run on a single hardware platform, which would be good news for PC makers, but not necessarily for IBM or Microsoft. Remember, these guys don't just want to sell you some software, they want to control your desktop. I, for one, am not so sure I want them to.

*Bryan Cholfin
Cambridge, Massachusetts*

SUPERFICIAL SATISFACTION

The article "Software Satisfaction and Support" (June 16, 1992), featured our KnowledgeMan product in the Database Management section. Although this survey is presented as a reliable indicator of the relative merits of each product and its support policies, there remain many complex issues surrounding intangible "satisfaction" that the survey fails to address.

Your research department was kind

enough to supply us with a copy of the survey, which we carefully examined. We were surprised to find that the readers were asked for only four pieces of information regarding each database product. They were asked if the product was the primary one they used and if they had used the product in the past two years. Then they were asked to rate their satisfaction with the product and with the product's support. These ratings are totally meaningless.

You conclude that "free technical support and a solid market image could add up to a positive user response." It is difficult to see how you draw this conclusion from the answers to just four questions, none of which address marketing issues or support pricing policies.

Many people trust *PC Magazine* to provide accurate and unbiased opinions about products. I think you owe it to your

*It's difficult to see how you
can draw conclusions about
service and support
from the answers to
just four questions.*

readers to do a real survey that explores in-depth the complex issues surrounding user satisfaction. At mdbs, customers get right through to technical support without waiting. Our consultants are professional developers who both understand the development process and can give comprehensive support down to the code level. It's not free, but you get what you pay for.

You claim that your readers value free support. For corporate customers, however, this is unlikely to be the case. Try calling one of the free technical support numbers: You'll be lucky to get through without a 30-minute wait. So how "free" is free support?

Product satisfaction also depends on many factors. What kind of development task is the product being used for? Who's using it? What kind of a match is the product for the task? Only when you comprehensively review products in their real-world contexts can you produce a

survey that draws reliable, accurate conclusions.

*Brian Straight
Director of Marketing, mdbs, Inc.
Lafayette, Indiana*

CORRECTIONS & AMPLIFICATIONS

The Micronics Mport 450/Color Mpression reviewed in "Color Hits the Road," (August 1992), is now sold by Apercom Corp., 1601 Industrial Way, #170, Belmont, CA 94002; 415-593-5818, which has purchased Micronics' portable computer division.

In "Multiuser Databases: Robust and Ready to Share" (March 31, 1992), we stated that DataEase was unable to complete our Report test within the time limit. We later found that the benchmark code provided by DataEase International for this test improperly timed the creation of the view on which the report was generated. As a result, the scores noted for this particular test are inaccurate.

In "Project Management for the Real World" (Michael J. Miller, June 30, 1992), the term CPM should have been referred to as Critical Path Method; likewise, PERT is the acronym for Program Evaluation and Review Technique.

The toll-free number listed for Ventana Press (Read Only, July 1992), 800-877-7955, is a fax number.

The actual price of NMB Technologies' keyboards ("Essential Peripherals," July 1992), are \$60 and \$70, respectively.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments and suggestions. Please send correspondence to Letters, *PC Magazine*, One Park Ave., New York, NY 10016, or upload it to PC MagNet (see page 10 for access information). All letters become the property of *PC Magazine* and are subject to editing.

Sitting in coach between
two sumo wrestlers,

I pull out my laptop and try to get
some work done. I futz with the clip-on
trackball. Untangle the cord. Meanwhile,
my screen flickers at me like a dim bulb.
I notice the guy across the aisle is
struggling with a mouse, trying to use
the back of the seat as a mousepad.
And I think to myself,

"This is making it easier?"

Then there's Macintosh® PowerBook. The one notebook designed from the beginning for anywhere/anytime computing. The trackball is built into the keyboard. Palm rests make it extraordinarily comfortable to use. That's why Byte said, "These new Macs with their ability to read DOS floppy disks, transparently connect to an office's AppleTalk network, and print to fax, make on-the-go computing easier and more productive than ever." That's why PowerBook was the only personal computer to make the Product of the Year lists of *Business Week*, *Fortune* and *InfoWorld*. And the only notebook computer to be named one of the Best Designed Products of the Year by *Time*. That's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* The affordable, compatible, connectable PowerBook personal computer. The power to be your best.

Macintosh from Apple.



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THE ZEOS '486 EISA

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—PC Week

"The ZEOS '486 offers the best choice of all!"

—Computer Shopper

"Outstanding!"

—PC Magazine



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Power. Editors' Choice!

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LOWER
PRICE!**

"A MUST FOR THE CORPORATE USER" — PC MAGAZINE



Unleash the power! Unleash your own ZEOS '486 EISA. *PC Magazine* calls it "out-standing." If it's your first '486, you will quite likely call it unbelievable. Believe it.

In awarding your new ZEOS '486 the coveted *Editors' Choice Award*, *PC Magazine* said the ZEOS '486 EISA was "best on our tests." They went on to note the ZEOS '486 is "both surprisingly useable and affordable." But that really shouldn't come as a surprise. After all, this ZEOS '486 powerhouse comes from a family of *nine* ZEOS Editors' Choice machines. Now let's talk real '486 power:

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It begins with the EISA bus. *PC Magazine* found that the 32-bit EISA bus when combined with our EISA disk caching controller will provide performance "easily twice as fast (and occasionally ten times as fast) as an AT-bus computer with the same microprocessor and megahertz rating." Now that's *fast*!

But what about compatibility? While the '486 processor offers full software compatibility, the EISA bus will accept your present eight- and sixteen-bit expansion cards and runs them without a hitch. That's the advantage of the EISA bus. Incredible performance with complete compatibility. That's your new ZEOS '486 EISA.

"TWEAKING AND REFINING"

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And, speaking of performance. In their *Editors' Choice* review, *PC Magazine* noted "ZEOS has a reputation for tweaking and refining that shows." That's the ZEOS way.

Attention to detail really makes the difference. We're talking about important details, items you may not even notice at first. Like two cooling fans in EVERY ZEOS '486. And cabinets loaded with drive bays. Loaded too with our high-capacity power supply and a motherboard that will take up to 32MB right on board. And more.

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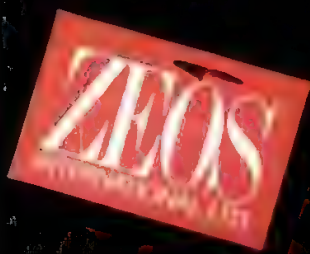
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CIRCLE 063 ON READER SERVICE CARD



HEY... EVER GET
DID YOU EVER GET
MY MEMO?

WordPerfect answers the most-asked question about electronic mail.

Click on "Send" in many of today's e-mail packages, and the urgent message on your screen will disappear, perhaps never to be heard of again.

You'll have no way of learning if it was ever delivered, or opened. You'll have no way of checking what you sent to whom, or when. And if you ever need to retract a message for corrections, well, *no way*.

So it's no wonder that in surveys of the features users would most like to see incorporated into their e-mail packages, message tracking ranks at or near the top. Except, that is, in surveys of WordPerfect® Office users.

An In Box Is Not Enough

In addition to the In Box that every e-mail package offers, WordPerfect Office gives you an electronic Out Box. So in addition to all the usual things you'll be able to do with your incoming mail (including read, reply, forward, save and print), we give you unusual control over your *outgoing* messages as well (including the ability to reread, rethink, rewrite and retract).

And the Out Box is just one of the features that separates WordPerfect Office from the rest of the e-mail pack.

E-Mail Everyone Can Agree On

If people would simply agree on a single computer platform, hooking everyone up with an e-mail system would be no trick. But since *that* shows no signs of happening, WordPerfect

Office is available for all of the most popular platforms, including DOS, Windows, Mac, UNIX, VAX and Data General.

With WordPerfect Connections (included in Office 3.1), a DOS and Windows LAN can connect seamlessly (and transparently) with VAX and UNIX LANs, for example. So a message that goes out in Windows can arrive in UNIX and lose nothing in the translation.

Getting Your Message Out

Far-flung empires will find WordPerfect Office equally accommodating, with gateways to messaging systems that include Novell MHS, IBM OfficeVision, DEC, X.400, SMTP, MCI Mail and AT&T EasyLink, among others.

And unlike e-mail packages that simply deliver the mail, WordPerfect Office includes powerful Calendar and Scheduling functions that provide entirely new ways for your people to work together productively.

Let Us Show You How It Works

With WordPerfect Office, the possibilities are nearly limitless. And the technical support for users and administrators is widely acknowledged to be the best in the business. To learn more, contact your WordPerfect Representative, or for a free video demonstration, call (800) 526-5266.

(Until you have a more effective means of business communication up and running, the telephone will have to do.)

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Point, Click, Drag, Drop. Now *This* Is DOS.

Norton Desktop For DOS

File Disk View Configure Tools Window Help

See how visually inviting and easy to use DOS can be.

Welcome to The Norton Desktop for DOS, a revolutionary new approach that gives DOS PC users visual drag-and-drop file management, in combination with a fully integrated set of easy-to-use utilities.



Drag-and-drop ease of use comes to DOS. To move files from your hard disk to a floppy drive just point and click.

Suddenly DOS takes flight.

Imagine sitting down to your DOS PC and finding an intuitive visual desktop where you can manage files and run programs with point and shoot simplicity.

Suddenly, you can move, delete, copy, print, view, backup, or scan

files for viruses, using the mouse to click, drag-and-drop. Or, use the keyboard.

And you can do all this with the security of Norton's acclaimed backup, virus protection, and data recovery utilities.

You can even set up schedules to automate your backup and virus scans, so you'll never have to worry about losing data.

All, without using a single DOS command!

Plus, when you're in between work sessions, colorful, animated screen savers pop up over any application.

Simply click on a file and drag it to our unique button bar to backup, print, or take other actions.



A new view of personal productivity.

The Norton Menu automatically creates a menu of your applications. View files from any of over 60 popular applications as they would normally appear—without taking time to load the application. Whether you actually have it or not.

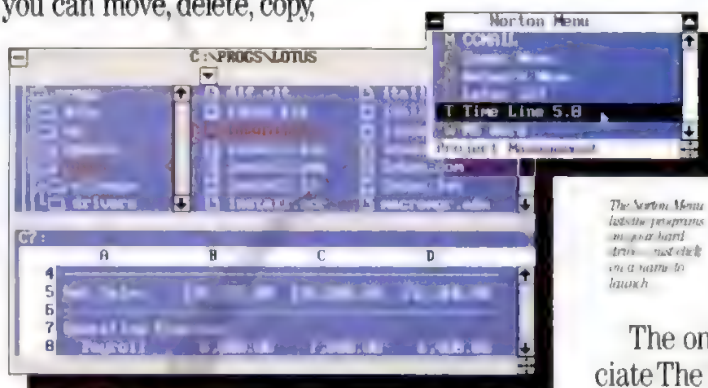
And because each function works the same way, once you've learned one feature, you'll be comfortable with the rest.



Peter Norton brings Windows' visual power and usability to DOS.

A Window on the future.

Because its companion, The Norton Desktop for Windows, uses the same interface and commands, you'll have an easy migration path to Windows.



Point-click on a drive icon to see all your files in a movable, resizable window. Below it is a menu pane showing a spreadsheet or any type of file you wish to preview.

The Norton Menu lists the programs on your hard drive—just click on a name to launch.

An investment with a guaranteed return.

The only way to truly appreciate The Norton Desktop for DOS is to see it yourself. The suggested retail price is only \$179,*

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1 Help 2 Menu 3 NAV 4 Backup 5 Find 6 Print 7 Move

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CIRCLE 264 ON READER SERVICE CARD

Intel's Brave New World

P5, though compatible, breaks with the past

Intel's heir to the 486 throne, code-named the P5, will break with tradition in a number of ways when it's released later this year. It won't be called the 586 because Intel had no luck protecting the names 386 and 486. But the real break is in the architecture and process tech-

nologies that command the P5 to perform as if it were breaking the laws of physics.

Rated at more than 100 MIPS, the P5 will be nearly twice as powerful as the 66-MHz 486DX2 (which Intel rates at 54 MIPS), and it will have three times as many transistors as the 486. The new chip will have a 16K cache—twice the size of the 486 cache—and the first version will run at 66 MHz, with faster speeds in the works.

The P5 will use a 32-bit instruction set but will have a 64-bit data path. To utilize the 64-bit I/O, PC vendors will have to redesign their systems. Compaq will be one of the first to support the P5, by means of the TriFlex architecture, which will be available in the next version of the Systempro. Compaq's TriFlex architecture will handle all comers with a 32-bit EISA bus, a 32-/64-bit processor bus, and a 128-bit memory bus.

According to Albert Yu, Intel's general manager of microprocessors, the P5's BiCMOS (bipolar complementary metal-oxide) process and superscalar architecture contribute to the chip's physics-defying performance. "BiCMOS adds

about 10 percent to the complexity of the chip design but gives you about a 30 to 35 percent performance benefit without a size or power penalty," says Yu.

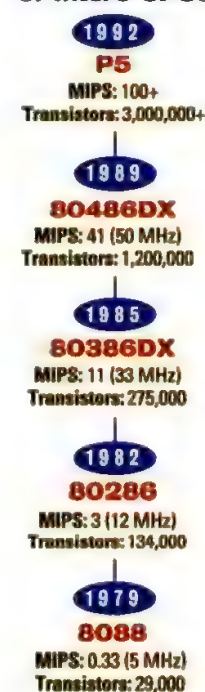
Intel moved to BiCMOS from the

CMOS process with a nod to the future. "At 66 MHz we're running out of bandwidth with CMOS," Yu says. "There's a chance we could go higher, but there's more headroom to go to 100 or 150 MHz in BiCMOS. I think we'll continue to use the BiCMOS process in the next couple of chip generations beyond the P5, too.

"Another factor in the P5's performance is superscalar architecture, which is a chip's ability to process two instructions per clock cycle," says Yu. The 386, by comparison, processes an instruction every two clock cycles, and a 486 does it in a single cycle. Superscalar architecture is usually associated with high-output RISC chips, and the P5 is the first CISC chip to be considered superscalar. Intel achieves this feat by having two integer units in the P5 that process instructions in parallel. The built-in 16K

Continues on page 34

Five Generations of Intel's CPUs



MIPS—million instructions per second
Source: Intel Corp.

Intel says the P5 will perform more than twice as fast as the 486DX.

Intel, VESA Go Separate Ways

LOCAL BUS WARS IT'S NOT, INSIST VESA board members. At the same time, they acknowledge their disappointment that Intel has decided not to pursue making its local-bus architecture—the Peripheral Component Interconnect (PCI)—compatible with the VESA Local (VL) bus spec (Trends, June 30, 1992). To minimize the damage, VESA intends to submit the VL bus to Intel for approval as a PCI slave, according to Ron McCabe, chair of the local-bus committee at the Video Electronics Standards Association (VESA).

Although the official message from VESA is peaceful coexistence, board members confide that the sore spot between VESA and Intel is the connection for add-on cards. A mechanical connector for attaching add-on boards to the system board is crucial to the acceptance of any local bus architecture by VESA members, many of whom manufacture add-on boards. But so far Intel has outlined only an electrical connection. According to Intel's PCI architect Dave Carson, defining the mechanical connector is better left to the new PCI Special Interest Group.

With VL bus-based products slated to arrive this fall—just as soon as VESA's full membership approves the spec—with little or no extra cost to the end user, the VL bus is well poised to deliver a short-term local-bus solution, enabling peripherals to run at CPU speed. But PCI was designed to support future applications with mixed data types, and it has ten slots to the VL bus's three. It may provide a more robust architecture for the long haul.

—Mary Kathleen Flynn

Clock Doubler Too Darn Hot

INTEL'S CLOCK-DOUBLING 66-MHz 486 DX2 arrives hot on the heels of the 50-MHz DX2 (see our cover story in this issue). Like a custom-built car from Detroit, the 66-MHz version looks like the familiar model,

Pipeline By Gus Venditto

Low Voltage from Laptop to Desktop

If you're looking for a power-stingy laptop in the next six months, you'll be seeing a lot of claims for new low-voltage 386 systems.

AMD and Intel are running yet another race, trying to get laptop makers to use their newly introduced low-voltage processors. Each company is pushing an 80386 that runs at 3 volts (actually 3.3 volts, but the "point 3" is getting stripped out in general use). A battery's life can be extended close to 40 percent by this switch, but the first round of laptops built on 3-volt processors, coming this fall, won't offer that much of a benefit.

The problem is that other system components (such as video logic and disk controllers) must be redesigned to run at the lower voltage. Right now, the only widely available chips that can run at 3 volts are RAM chips. So Intel has come up with a way to run a system at 3 volts with a "flexible-voltage" 386SL processor. The processor and memory interface run at 3 volts, while the other components run at 5. The system boards for new laptops are being designed with "hybrid planes," which means there will be signals running at both voltages. AMD's 3-volt 386 is not quite as smart as Intel's, but the company points developers to translation logic from Western Digital and VLSI Technology that accomplishes the same thing.

Neither of these designs was ready for evaluation yet, but you can expect to see a good number of laptops using these chips. AMD's solution may not be as elegant as Intel's, but it costs half as much.

Many vendors are going to wait out this first wave of mixed-voltage portable computing. By early next year, there should be enough suppliers of 3-volt components to permit building a purely 3-volt system. But there won't be a large difference between mixed-voltage and purely 3-volt systems. A well-designed mixed-volt system could extend battery life up to 26 percent, while a fully 3-volt system could extend it by 40 percent.

Once the development of 3-volt components is complete, you can expect to see a regular stream of 3-volt systems. In fact, this technology will probably end up as the dominant desktop standard for two reasons.

First is the long-term need to cut back on energy usage. Two federal agencies, the Department of Energy and the Environmental Protection Agency, are developing programs to help businesses save electricity. A rating system for all types of computing equipment is in development (something like the ratings used on air conditioners and refrigerators), and it will help get that message across.

And second, the low-voltage systems will help solve one of the biggest problems facing system designers: heat. Low voltage means cool computing.

Gus Venditto is editor of *PC Sources* and a contributing editor to *PC Magazine*.



PHOTOGRAPH BY PETER GREIGORE

but under the hood this baby is built to burn. Literally. It seems the speed-doubling technology generates searing heat.

Blazing along at 66 MHz internally, the DX2/66 is arguably Intel's fastest processor. Intel rates the DX2/50 at 40.7 MIPS, the straight DX/50 at 41 MIPS, and the DX2/66 at 54 MIPS. To lower the temperature, Intel recommends adding some type of cooling device.

In the first three systems we've seen, PC vendors have approached the cooling problem in unique ways. IBM, using the DX2/66 in its Model 90 XP 486 system, puts a

bronze-colored metal heat sink on the actual chip. This has a number of pointy prongs sticking up about a quarter of an inch, like miniature cones, to dissipate the heat.

In the VectraU/66, Hewlett-Packard doesn't use a hardware device attached to the chip. Instead, it relies on two temperature-controlled fans that kick in if the chip heats up. Fountain Technologies' 486/66 DX2 uses a heat sink that has an actual fan attached to the chip. Besides being funny-looking, the chip-size fan prevents three expansion slots from accepting full-size cards.

As Lew Pacely, Intel's 486 marketing



To lower the heat, IBM puts a metal heat sink on the DX2/66 in the Model 90 XP 486 system.

manager, says, "There's no way around it: High clock rates generate more heat." Although the DX2/66 is rated to operate at temperatures much higher than the normal operating temperature, Intel may sell future versions of the DX2/66 with a heat sink already installed.

Intel is not taking any chances with the 66-MHz OverDrive, which is the do-it-yourself version of the DX2. This chip, due in August, will come with a heat sink attached.—Christopher Barr

FDDI-Over-Copper Still Pricey

IF BRINGING DATA TO THE DESK-top at 100 megabits per second sounds like a panacea for your networking problems, think again. Even though the industry is coalescing around a single FDDI-over-copper specification, running FDDI to the desktop will be an expensive proposition.

The costs of implementing the Fiber Distributed Data Interface (FDDI) have always held back the high-speed spec. The big hurdle has been that ANSI's original specification was designed for transmission over fiber-optic cabling, which required users to throw out their existing copper cabling. But during the past year, networking vendors AT&T, Cabletron Systems, Crescendo Communications, Digital Equipment Corp., SynOptics Communications, and Ungermann-Bass have developed different encoding schemes for running the high-speed FDDI signals across existing copper cabling—both shielded twisted-pair (STP) and, in some cases, unshielded twisted-pair (UTP). In June, ANSI took a big step toward standardizing on FDDI by consolidating around a joint proposal made by Cabletron and Crescendo.

Even with a standard FDDI-over-copper spec, some significant cost barriers may thwart FDDI's acceptance. New network adapters are still priced at more than \$1,000, and that's on the low end of the range. What's more, the FDDI-over-UTP specification will work only for data-grade wiring, which has been on the market only for the past two years or so. (Most UTP installations are based on the less robust voice-grade type.)

Vendors still have a long way to go before they will be able to implement a robust FDDI-over-UTP solution. "We don't really know if the standard's good enough," says Pat Thaler, a Hewlett-Packard spokesperson. "Without a lot more work, we won't be able to implement FDDI over UTP. And even then, most will probably need a new cabling plant."—David Greenfield

Top Retail Software		
Current ranking	Last issue	Product/Company
1	4	Microsoft Windows 3.1 Upgrade Microsoft Corp.
2	3	WordPerfect 5.1 for DOS WordPerfect Corp.
3	6	Microsoft Windows 3.1 Microsoft Corp.
4	5	Microsoft DOS 5.0 Upgrade Kit Microsoft Corp.
5	1	QEMM-386 6.0 Quarterdeck Office Systems
6	12	Stacker 2.0 Stac Electronics
7	8	WordPerfect 5.1 for Windows WordPerfect Corp.
8	2	Excel for Windows 4.0 Upgrade Microsoft Corp.
9	13	Word for Windows 2.0 Upgrade Microsoft Corp.
10	9	Procomm Plus 2.1 DataStorm Technologies
11	—	OS/2 2.0 Upgrade IBM Software
12	7	Word for Windows 2.0 Microsoft Corp.
13	15	Quickon 5.0 Intuit
14	—	Excel for Windows 4.0 Microsoft Corp.
15	—	Lotus 1-2-3 2.4 Lotus Development Corp.

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending July 11, 1992. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

Tools for Windows-Mac Development

WRITING APPLICATIONS THAT will run on more than one operating system will soon get easier, which is good news for developers who must target their applications at corporate computing environments that are increasingly diverse. Symantec recently announced an ambitious technology called Bedrock, which will initially let developers create applications simultaneously for Windows and the Macintosh. Eventually, Symantec expects Bedrock to support Windows NT, OS/2, and Unix as well. And Microsoft is currently working on tools that will make it easier for developers to write for both 16- and 32-bit Windows and to port their apps to the Macintosh.

Bedrock is still in the development stage. Beginning this fall, products will be marketed both by Symantec, which created it, and by Apple, which plans to replace its current Macintosh development environment, MacApp, with Bedrock.

Bedrock is an object-oriented set of class libraries written in C. The idea is that developers will write to Bedrock instead of to an operating system-specific application program interface (API).

That sounds great, but what about functions that are supported in one OS but not in another? "We believe that the commonality among operating systems is about 70 to 80 percent," answers Symantec CEO Gordon Eubanks. "But Bedrock isn't intended to make programming transparent, just easier." Although Eubanks is adamant that Bedrock "is not a lowest-common-denominator approach," he does acknowledge that some particularly knotty issues are involved in mapping one OS to another. One example he cites is the difference between Object Linking and Embedding (OLE) in Windows and Apple Events on the Macintosh. "There's a big difference between how programs communicate with each other," he says. "We have a strategy to deal with that, but we aren't ready to talk about it yet."

Microsoft's announced cross-platform

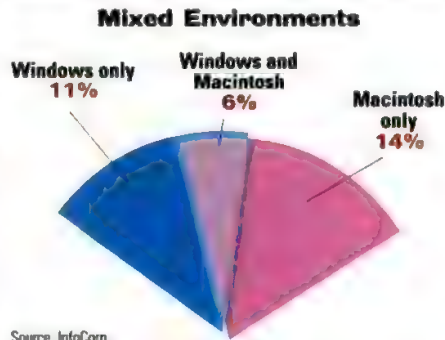
plans are less ambitious than Symantec's. Microsoft has promised to make it easier to develop 32-bit apps that will run on both 16-bit and 32-bit Windows in a future release of the Win32 Software Development Kit (Trends, August 1992). And to woo Macintosh developers away from Apple, Microsoft is working on a project code-named Alar (after the preservative that made head-

lines in 1989 when its reported potential for causing cancer scared consumers off apples). According to Jim McCarthy, director of marketing for Microsoft's development tools group, Alar is a Windows API for the Macintosh that should make porting Windows apps to the Mac much easier than it is today.

As corporations

downsize, upsize, and even rightsize, applications that can run on multiple platforms promise to become increasingly important. And given Microsoft's growing emphasis on Windows as a scalable operating system, more sweeping cross-platform development environments seem destined to emerge.

—Mary Kathleen Flynn



Today, only 6 percent of installed networks include Windows and Macintosh machines, but Symantec and Apple are betting this number will grow.

VxD: Free Lunch After All

VIRTUAL DEVICE DRIVERS (VxDs) for Windows, which Microsoft Corp. is actively encouraging hardware vendors to write, promise improved memory management for DOS sessions as well as performance boosts under Windows (Pipeline, May 12, 1992).

Already, at least one example of this technology is on the market: LaserMaster's WinPrint Manager, for use with the same company's WinPrinters and WinJet add-ons for lasers. It sets up virtual ports using a VxD and is able to get control when data is sent to those ports from DOS sessions. It provides a print spooler and a full-fledged PostScript interpreter. While it does take a multimegabyte chunk of extended memory, no memory is taken from below the 1MB boundary in DOS sessions.

Also forthcoming is Microsoft's recently announced Windows for Workgroups, which will provide peer-to-peer networking

on systems with suitable hardware. DOS sessions will get network support only through Windows, but because network support will load as a VxD, it will come at no sub-1-megabyte memory cost.

With this technology being developed, we are likely to see some specially written VxDs that act like TSRs in DOS sessions with little or no memory cost.

—Barry Simon

Brave New World

CONTINUED FROM PAGE 31
cache fuels the dual integer units.

Like RISC chips, the P5 has a powerful floating-point unit (FPU). According to Yu, "The FPU in the P5 has been rewritten and performs significantly better than the 486. It will be totally compatible with the 486 and the 387 math coprocessor."

Although any current software will run on the P5, which is 100 percent backward-compatible with the 386 and 486—and the software will run faster because of the architecture—developers will have to recompile their applications to exploit the P5's true power. "Another contributing factor to performance is compilers, and we've developed compilers to take advantage of what we have," says Yu. "We'll license the technology to the compiler companies so they can take advantage of the superscalar capability of the P5." —Christopher Barr

Help Yourself to Tech Support

TECHNICAL SUPPORT MAY NO longer mean a programmer or technician waiting by the phone. A new crop of products help people help themselves to the answers.

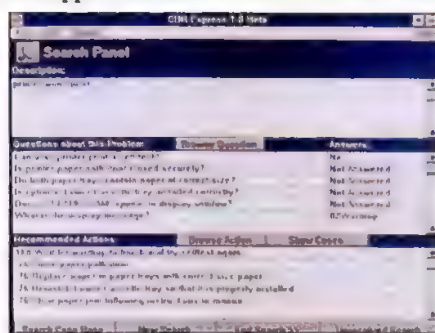
Inference Corp. leads the way with CBR (for "Case-Based Reasoning") Express, a Windows-based help desk database tool that intelligently organizes support information, which users access on a case-by-case basis. Support personnel interact with CBR Express in plain English, even when they are unfamiliar with technical terms, and the system asks appropriate questions to aid in identifying a solution. (The development software costs \$9,995, the authoring software \$4,995, and the runtime software \$1,995. Call 310-322-0200.)

CBR Express has already collected an impressive customer list. Compaq, for example, uses the product in its new SMART (Support Management Automated Reason-

ing Technology) system for customer service, which handles questions on networking and applications as well as on Compaq's hardware. CBR Express is also being used by such companies as Texaco and GTE for internal help desks, and by American Airlines to manage field calls from travel agents who use its system for billing and accounting. Inference's newest product, SearchLite (\$595), lets vendors create "smart" PCs by bundling case bases with PCs.

Although Answer Computer's Apriori does not use interactive case-based reasoning, it does offer an information base of technical solutions, which can be searched

by symptom, keyword, or ID number. The most commonly asked questions eventually bubble up to the top and are the most easily accessible. Customers such as JC Penney and Interleaf have jumped on the Apriori wagon. (Pricing starts at \$55,000 for five users. Call 800-



Inference's CBR Express: Help for the help desk.

677-2679 or 408-739-6130.)

Vycor's Helpline is designed for internal use only. Entering a problem description at the help desk brings up the caller's system configuration and lists similar problems with solutions. Helpline can analyze trends in help desk calls to identify special needs, and it can act as a help desk manager by logging, prioritizing, and monitoring calls. (Pricing starts at \$1,295 for single users and \$3,495 for a five-server network. Call 301-220-4450.)

Another resource for help desk managers is Support on Site. The service is available from Computer Library, a division of Ziff Communications Co., the parent company of *PC Magazine*. Support on Site is a CD-ROM with a wealth of software support information. Aldus, Borland, Lotus, Microsoft, and WordPerfect are a few of the vendors that have provided tech notes, manuals, newsletters, and even drivers, macros, and fixes to the Support on Site database. (An annual single-user subscription, with monthly updates, is \$1,295; a five-user LAN subscription is \$4,995. Call 212-503-4400.)

And if this array of products doesn't give you everything you need to create the perfect help desk, the Help Desk Institute in Colorado Springs (719-531-5138) offers training, educational materials, and forums for help desk professionals.

—Brad Grimes

Briefs

"WATCH THE WPMA" whisper some software developers who hint that the same folks who ganged up on Microsoft over e-mail turf will do it again on database territory. Led by Lotus, a group of vendors that includes Apple, Borland, IBM, and Novell have proposed the Vendor Independent Messaging (VIM) spec as an alternative to Microsoft's Mail Application Programming Interface (MAPI), which recently won support from Apple. The same group may wage a counterattack on Microsoft's Open Database Connectivity (ODBC), which would likely be based on Borland's Open Database Application Programming Interface (ODAPI).

STEVE JOBS MAY BE finally embracing Intel's architecture—he expects to deliver a version of the NeXTStep environment for the 486 in the fourth

quarter—but he's still keeping his distance from the company he co-founded. "Apple hardware is still not powerful enough for us," he says. He's also critical of QuickTime, Apple's architecture for synchronizing audio and video: "It's a bad idea for real-time, interactive applications like video conferencing, although we might support the file format."

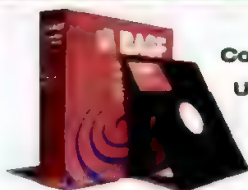
LOTUS'S PLANS FOR its Realtime spread-sheet have gone way beyond a mere Lotus 1-2-3 for traders. The company hopes it will become the leading desktop integrator of on-line databases for financial services applications. Lotus recently released the Lotus Realtime Application Programming Interface and versions of the product for NeXTStep (with Improv) and for the IBM RISC System/6000 Workstation (with 1-2-3 for Unix). —Mary Kathleen Flynn

IT'S EASY TO SPOT FAULTY DISKS. COMPUTERS SWEAR BY THEM.

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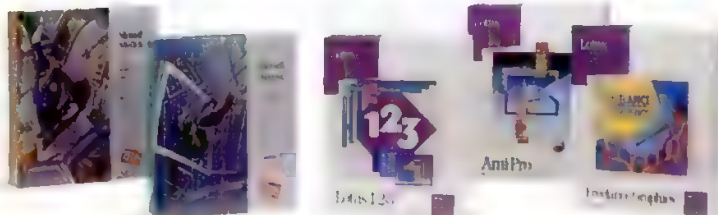
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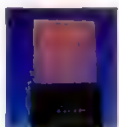
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Ami Pro 3.0 Adds Easy Mail-Merge and Advanced Macros

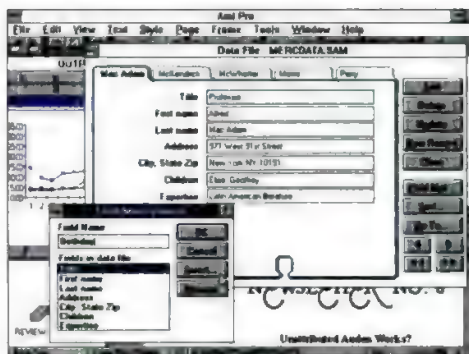
BY EDWARD MENDELSON

Ami Pro, already the most visually spectacular and graphically adept of Windows word processors, is now the most flexible and customizable—and many of its crucial features are the most powerful and the easiest to use.

In Version 3.0 of Lotus's \$495 package, mail-merge and the creation of a database are more visual and intuitive than ever. You can now preview both stylesheets and documents on the same menu that lets you open them. A click on the right mouse button anywhere on a page brings up the dialog box you're mostly likely to want for modifying the format of whatever is under the cursor—a graphics or text frame, ordinary text, or tables. Advanced and corporate users now have access

to a spectacularly powerful macro language unlike anything else available in a word processor.

Ami Pro remains the only Windows word processor with fully integrated tables and charting, drawing, equation, and image-processing modules that compare favorably with standalone packages. These modules let you edit any graphical element in the same window with its surrounding text. The program now defaults to using its



MAIL CALL: *Ami Pro's automated mail merge has been vastly improved.*

While rival packages have not imitated these conveniences, Ami Pro now includes improved versions of many of its rivals' best features. Its automated mail-merge one-ups the PrintMerge Helper in Word for Windows by guiding you through every step and letting you use an intuitive card-file metaphor when

creating a database. You can use drag-and-drop editing in text and tables. The stylesheet menu

• *Continues on page 42*

Printers

Sharp Output from Canon's \$10,000 Color Printer, Copier, Scanner

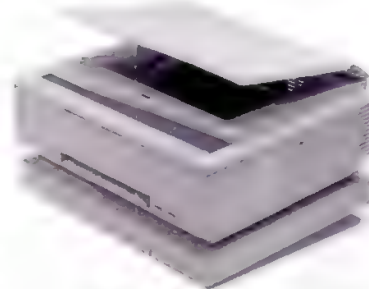
BY ALFRED POOR

As Windows applications continue to proliferate, their users are demanding better color output solutions. If the new Canon CJ10 color printer, scanner, and copier doesn't satisfy them, nothing will.

At \$10,295 (\$300 more for Micro Channel), the CJ10 is not so much a product as a combination of products. The base is a standalone color copier (\$6,995), to which you add an Intelligent Processing Unit printer controller with a SCSI interface (\$2,700) and a SCSI interface card with its own drivers (\$600 for AT bus, \$900 for Mi-

cro Channel).

The heart of the product is the copier, which weighs in at a reasonable 43 pounds. Designed with Canon's color Bubble Jet technology, it uses four separate cartridges with integral ink jet print heads for black, cyan, yellow, and magenta inks. The cartridges are rated for 1,000 pages at 7 to 8 percent paper coverage, and they cost \$90 each. The machine requires special coated paper, which costs \$21 per box of 200 sheets. All this adds up to an average cost of 46.5 cents per



ALL IN ONE: The Canon C110

page, though the cost goes up as page coverage increases.

Thermal transfer printers have a similar per-page cost, but most thermal transfer printers can't act as copiers, and the CJ10 can. Put a color image on the glass plate on top, press a button, and in about 90 seconds,

• *Continues on page 44*

FIRST LOOKS PLUS

With this issue, *PC Magazine* begins a new on-line service:

First Looks Plus. In PC MagNet's Editorial Forum on ZiffNet you'll find the names of the writers of selected product evaluations and a vendor representative for each product. They'll host a discussion of each product and answer questions. You can also download a working demo. Dates and instructions appear at the end of the review.

■ Desktop Publishing

FrameMaker Brings Workstation DTP Power to Windows

BY EDWARD MENDELSON

Frame Technology Corp. has brought the leading multiplatform publishing program for large documents to the PC. At \$795, FrameMaker 3.0 for Windows has features and conveniences that Windows-based desktop publishers have envied for years: multiple documents open at the same time, simple creation of hypertext documents, conditional text that permits multiple versions of the same file, a graphics module that lets you draw Bezier curves, tables with cells and rows that you can rotate 90 degrees, and an equation editor smart enough to solve the equations it formats.

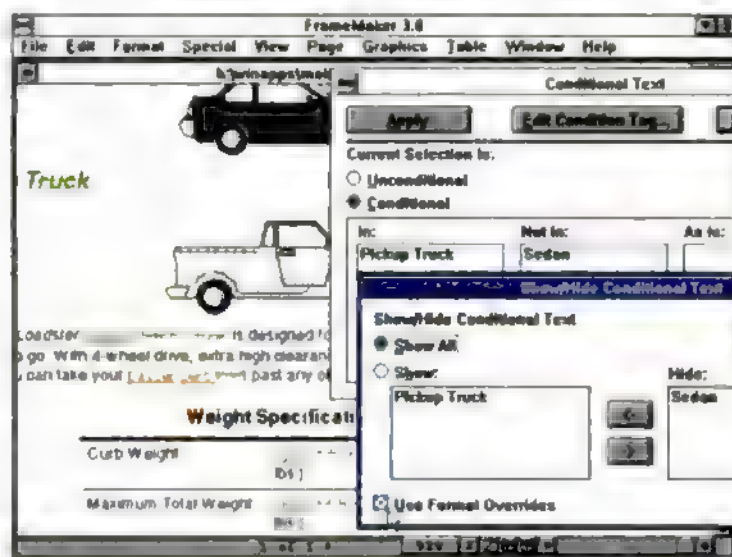
Corporate users frustrated by the limitations of Ventura Publisher will probably migrate to FrameMaker by the thousands. But they'll make the switch only if they're willing to give up Ventura's unique typographic controls in exchange for FrameMaker's cornucopia of features and its ability to share a network with versions that run on workstations, NeXT, and Macintosh machines.

STRUCTURED DOCUMENTS

The program is so large and complex that you may not consider using it unless you need to create large and complex documents. Yet its advanced graphics and ability to flow text across widely separated columns or pages also make it suitable for design-intensive newsletters and brochures. But unlike some other Windows DTP packages,

you'll need at least a Super VGA monitor to avoid a frustratingly crowded screen when using FrameMaker.

Like other DTP packages, FrameMaker formats docu-



OPTIONS: When you create conditional text—multiple versions of a document—FrameMaker lets you view it all at the same time.

ments on the basis of customizable templates that include paragraph styles. Unlike rival packages, FrameMaker lets you include up to 25 page layouts in a template, and lets you supplement paragraph styles with character styles for use with text blocks smaller than a paragraph. (Character styles are otherwise available only in Microsoft Word for DOS, and, inconveniently, in WordPerfect.)

FrameMaker keeps a template's page layouts in "master pages" that you can transfer from one document to another but that you can't print. If you modify a printable document page, you can copy its layout to a master page, or reformat it on the basis of another master page. Templates also include "reference pages" that store elements such as tables, cross-reference formats, lines, graphics, and pop-up menus for hypertext

files so you can insert them easily anywhere in a file.

Paragraph styles incorporate options such as automatic numbering, word spacing and letter-spacing, and automatic placement of lines or graphics above or below the paragraph. Although FrameMaker has no macros, you can automate the creation of simple documents by combining the feature that lets you specify the style of the paragraph after the current one with an auto-numbering setting that uses text instead of a number. In this way, you can "number" the opening paragraph of a docu-

ment with the word "To"; when you type in a name and press Enter, the next paragraph can have a style that includes the word "From."

WORD PROCESSOR, TOO

More than any other DTP package, FrameMaker can be used effectively as a word processor, but it has some annoying quirks. Unlike virtually all other PC programs, it uses Alt-Left and Alt-Right (instead of Ctrl-Left and Ctrl-Right) to move through the text by word. Because it uses the standard Ctrl-Backspace and Ctrl-Delete to delete words, your fingers twist awkwardly between Alt to Ctrl when you shift between navigating and deleting.

You can select paragraph and character styles either from

separate windows with lists of styles or in a field on the status line at the foot of the screen. If you use the status line, you need only type in the first letters of the style name until you identify a unique style and the program completes the name for you.

You can tell the program to use true quotation marks rather than vertical strokes as you type, and you can also make it eliminate extra spaces typed between words or sentences. FrameMaker lets you use special typographic characters like the thin space and a space the same width as a numeral, but you can enter them only with keyboard codes buried in the help screen and reference guide. You can't enter most of these special characters in dialog boxes, so they can't be used in auto-numbering or other special formats. To enter symbols or dingbat characters in some dialog boxes, you'll need special codes available from tech support or Frame Technology's BBS. (CompuServe support is due later this year.)

WYSIWYG ALL THE WAY

All editing is done in a WYSIWYG view zoomable from 25 to 1,600 percent. You can edit and zoom in facing-page view. Annoyingly, if you click twice on the pop-up menu that lets you choose a preset view size, you reach the submenu that lets you set the percentages in the main menu.

You'll need a lot of screen

■ Will It Be Ventura, PageMaker, or FrameMaker?

FrameMaker can't provide all the color and typographic capabilities of its long-established rivals in the PC market. Where FrameMaker offers eight colors, Aldus PageMaker and Ventura Publisher give you 255 and let you import 24-bit color graphics. For design-intensive documents, PageMaker uses a pasteboard metaphor that lets you keep text and graphic elements visible outside the page.

Ventura allows you to create drop capitals at the start of paragraphs, and lets you control the size and position of the underline attribute. Ventura warns you when text lines are loosely spaced; PageMaker warns you of lines that are too loose

First Looks

real estate in order to use the editing tools conveniently. The paragraph format menu, for example, stays on-screen until you explicitly close it, and unless you have a high-resolution monitor, you will constantly move it around to see your text. The search-and-replace menu is smart enough to know how to replace a search string with the Clipboard contents, but not smart enough to move out of the way automatically so that you can see the string it locates in your text.

An optional set of 13 foreign-spelling dictionaries costs \$195. You can specify the dictionary to use in any paragraph, but you cannot specify any part of a paragraph, as you can in Word for Windows.

Expect frustrations if you import another word processor's files using any of FrameMaker's nearly 50 import filters, most of them licensed from Mastersoft's Word for Word. The WordPerfect filter works reliably, but the Word for Windows filter produces unpredictable results, with many left-justified paragraphs converted to centered text and many paragraphs wrongly formatted with page breaks immediately above them. When the program is aware of import problems, it displays incomprehensible messages in a special window. A Ventura filter is likely to arrive later this year.

One startling weakness in FrameMaker is its treatment of

FACT FILE

**FrameMaker 3.0
for Windows**

*Frame Technology Corp., 1010
Rincon Circle, San Jose, CA
95131; 800-843-7263, 408-433-
3311; fax, 408-433-1928*

List Price: \$795

Requires: 4MB RAM, 10MB hard disk space, Windows 3.0 or later.

In Short: An overwhelming, powerful publishing program best suited for long documents, but with flexible graphic features for design-intensive work. A few weaknesses (notably in footnoting) are troublesome, but they don't detract from the unique convenience and flexibility of this package.

 ON READER SERVICE CARD

footnotes. A long footnote doesn't get divided between the current page and the next page, but is pushed entirely to the next, leaving its reference number behind. You can create endnotes only manually and laboriously by using a separate part of your document to store cross-references back to the main text. Both problems will disqualify the program for many potential users.

As in other DTP packages, printing from FrameMaker is moderately slow. A document that Word for Windows sends to the printer in 35 seconds takes 55 seconds in FrameMaker. One convenient feature is the ability to print thumbnail views of multiple pages.

or too tight. Ventura makes it easy to create "outdented" headings.

For workable footnotes, stick with Ventura. For endnotes, stick with a word processor. For design-intensive documents, PageMaker is easiest to use, but keep in mind the impending Windows arrival of PageMaker's Macintosh rival, QuarkXPress.

Also keep in mind that new versions of Ventura and PageMaker are rumored to be in the works. The upcoming release of PageMaker will reportedly let you open multiple files at the same time, and Ventura may receive a drastically revised architecture.

You can find many of FrameMaker's long-document features and conditional text in Interleaf Publisher, along with a nonstandard interface and limited compatibility with other PC software.—EM

STRONG GRAPHICS AND EQUATIONS

FrameMaker's graphics and equations are generally more powerful than anything found in rival packages. Graphics tools include freehand curves and arrows with customizable arrowheads. Graphics imports are impressively accurate and reliable. You can print color separations, but the program supports only eight preset colors. The program won't flow text automatically around irregular graphics, but makes it easy to do the job manually.

The extraordinary equation editor uses a palette of symbols and functions to create an equation, and, like the one in MathCAD, lets you rearrange and evaluate the equations that you type. Equations are so dynamic that it's surprising to find tables so static. Tables can include graphics and equations but, as in lesser DTP packages, if you want to include an active spreadsheet, you will need to embed an Excel or other Windows spreadsheet via Windows' Object Linking and Embedding (OLE). Tables can span multiple pages, but (unlike Ami-

Pro) FrameMaker can't split a row across a page break when the cell contains multiple lines of text. Release notes included with the package warn of a bug that can shut down the program while you format a table.

You can build hypertext documents simply if you're willing to plan them in advance. The program's release notes are a FrameMaker hypertext document, and you can easily unlock it and study it as a model. You can also borrow from it the well-designed button icons that users click on to move through their text.

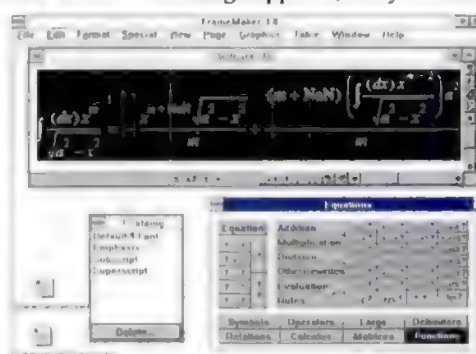
Hypertext documents work quickly and cleanly, but not so

quickly that you won't be annoyed that the program uses a hypertext file for on-line help instead of the Windows help engine.

MANAGING THE PUBLISHING PROCESS

Building and managing large documents is as close to effortless as you can imagine. You store the names of individual chapters in a "book" file, and then generate lists, tables of contents, and indexes easily from a menu. List formats are elaborately customizable, and index entries can span multiple pages. Cross-references work smoothly between files.

Users on a network can edit FrameMaker files created and stored on different platforms. If another user accesses a file you're working on, a warning message appears, but you can't



ADD IT UP: Click on "Evaluate," and FrameMaker's equation editor lets you evaluate or solve equations from a pop-up menu.

prevent the other user from editing the file. You can lock a document against editing, but anyone can use a series of keystrokes to unlock it. This keystroke sequence is one of many that aren't accessible from a menu, so you'll need the manual handy until you remember it.

FrameMaker ranks as by far the most capable and ambitious desktop publishing package for the PC. Its enormous strengths outweigh its minor flaws. If you need an up-to-date, flexible, multiplatform system for creating long documents, and if you can live with its weak footnoting, FrameMaker is your only choice. □

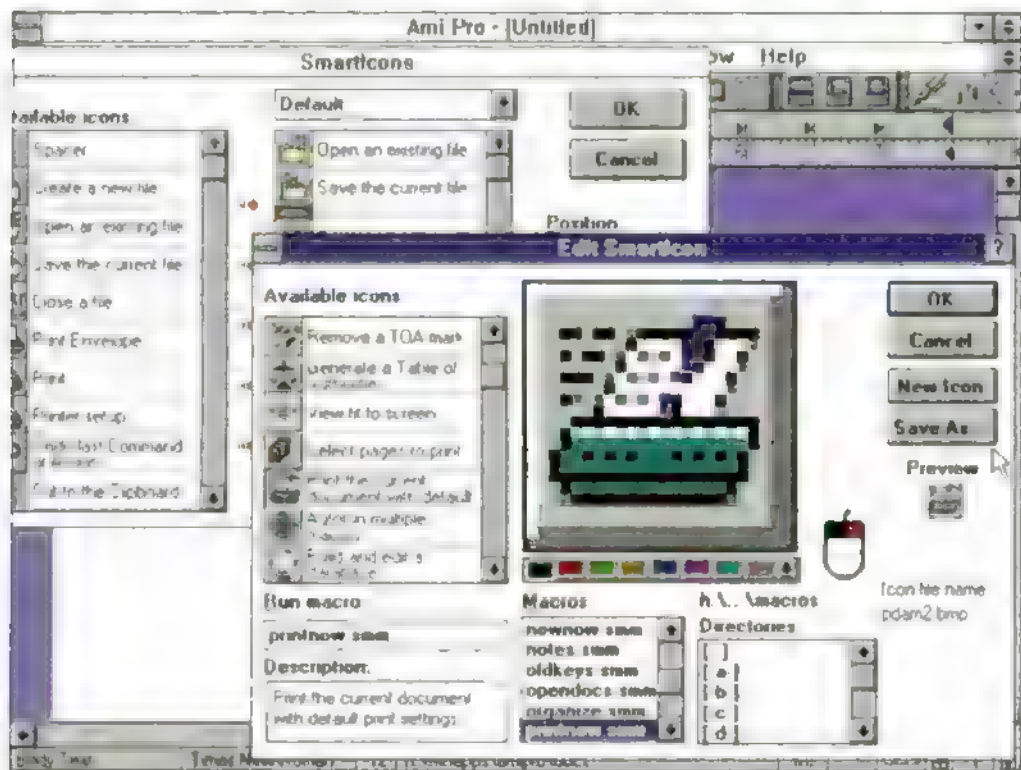
Ami Pro

CONTINUED FROM PAGE 39

includes a brief description of the stylesheets' contents.

As in Word for Windows, you get one-click envelope printing, but with a choice of preset return addresses. (To change character formatting on an envelope, you modify the ~AMIENV stylesheet—a trick buried deep in the help file.) As in WordPerfect for Windows, you can print labels from a simple menu. Ami Pro now in-

Ami Pro has always offered more accurate WYSIWYG views than any other word processor. In earlier versions, the current line of text flickered annoyingly after almost every letter you typed as the program recalculated spacing; the flicker is finally gone. You can view a document from 10 to 400 percent of its original size with the Zoom feature and view (but not edit) facing pages. Draft mode uses the same fonts as normal view and increases speed by ignoring most page formatting.



ICON DESIGN: You can create custom icons for Ami Pro's SmartIcon palette. Though the feature is not as flexible as a separate icon editor, no other word processor has anything like it.

cludes a built-in grammar checker, but unlike the one in Word for Windows, it won't check grammar and spelling in one pass.

NEW CONVENIENCES

The active and responsive Ami Pro screen conceals many new conveniences. You can create multiple icon sets for the floating SmartIcon palette and switch among them with a click on the status bar at the foot of the screen or an icon in the palette itself. As before, the status bar gives you instant access to fonts, styles, point sizes, and other functions.

If you like, though, you can strip the status bar, ruler, icons, and even the top-line menu off the screen so you can work on an absolutely clean display that looks like a DOS program.

An outline mode, complete with well-designed controls for collapsing and expanding, lets you select a special set of fonts so you can see the structure of your outline more clearly on the screen and page.

Dozens of small but valuable improvements grace the new version. You can select text with the mouse, apply formatting, and then use a Fast Format feature that applies the same formatting to the next text you select (Word for Windows has a similar feature, but it is harder to use). A table-of-authorities feature, stronger than Word for Windows' and WordPerfect's, makes the program ideal for legal use. You can choose an option that right-aligns the numerals in a numbered list, so that the periods following the numbers are in a vertical line. You can

also prevent hyphenation at the end of the last full line of a paragraph or page.

You now insert special characters with a macro that adds Windows' Charmap utility to the Insert menu. Ami Pro finally joins other high-end word processors in offering the crucial convenience of letting you print the current page without typing its page number. The program's import filters are markedly better than those in rival packages.

HEAVY-DUTY MACROS

Ami Pro's macro language allows for unmatched automation and customization. Macro programmers can now access dozens of Windows functions, so macros can perform graphics tricks like drawing a frame in slow motion, dragging any object across the screen, or displaying windows that contain graphics and text. You can create macros that respond at any time to keystrokes and mouse clicks, not only when the macro is idle.

You can now flag a document as a specific kind of file by using a macro, and the program can then change its menus and icons when that document is active. This feature is more flexible than the more familiar macros that let you link different environments with different stylesheets.

Compared with the macro language in Word for Windows, Ami Pro allows faster and more powerful programming, with a more flexible dialog-box editor that even amateur programmers can use easily. For automated word-processing applications, especially in corporate settings, Ami Pro ranks far ahead of all rivals.

Despite all these unique strengths, Ami Pro's architecture still has weaknesses that may make some advanced users pause be-

Ami Pro, Version 3.0
 Lotus Development Corp.,
 1000 Abernathy Rd. NE, Bldg.
 400, Atlanta, GA 30342; 800-
 831-9679, 404-391-0011;
 fax, 404-698-7653

List Price: \$495, upgrade, \$79, upgrade from competing products, \$129
Requires: 2MB RAM, 10MB hard disk space, Windows 3.0 or later
In Short: The most graphical of Windows word processors is now the most powerful overall, with convenient mail-merge and a superb macro language

429 ON READER SERVICE CARD

fore choosing it. Unlike Word for Windows, it won't let you edit different parts of the same file in different windows and retain all your edits when you save. Ami Pro uses its bookmark feature to mark text for many functions, but unlike Word for Windows, it doesn't let bookmarks overlap each other, so you'll face problems when you need to mark the same text for different purposes.

You still can't view the foot of one page on the same screen with the head of the next page—unless you switch to draft

mode, in which case you'll lose sight of most page formatting. You can't press a key to turn on a selection mode, then use functions on the menu to extend the selection. You can't search for two adjacent carriage returns. And the master document feature remains awkward and confusing.

If these problems don't faze you, you'll find Ami Pro 3.0 to be the most powerful and enjoyable of all Windows word processors. You'll also find that it's the fastest with most significant features, the richest in graphics, and the most at home in Windows' graphical environment. □



To download a working demo of Ami Pro from PC MagNet, type GO ZNT:DEMOS from any CompuServe prompt. From September 14 through September 18, you can go online to discuss Ami Pro with Edward Mendelson and Lotus product manager Bill Jones. Type GO ZNT:EXEC.

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IIT



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So why settle for data compression with exceptions? Instead, choose the data compression that's exceptional: XTRADrive.

IIT INTEGRATED INFORMATION TECHNOLOGY

Canon CJ10

CONTINUED FROM PAGE 39

you get a color copy. And unlike thermal transfer printers, the Canon CJ10 is ready to go after just a 10-second warm-up.

The copy is made by scanning and digitizing the image at 400 dots per inch and 256 colors, then printing it. The paper is fed from a 90-sheet paper tray that fits inside the printer. You can also feed single sheets via a manual-feed tray.

The fact that the image is digitized means that you can transform it using front-panel controls on the copier. You can make the image lighter or darker, adjust the color balance, or set the number of copies. You can even adjust the zoom, from 50 to 200 percent in 1 percent increments, and you can choose different zoom settings for the x and y dimensions to squeeze the image.

The results really have to be seen with your own eyes to be believed. Colors are vibrant and very accurate. The copier defaults to line-art copying, but you can press a button to improve contrast and definition for scanning and copying of photographs.

As if to prove just how good the CJ10's color copying is, the machine's copier lid carries a list

of items you are forbidden by law from copying, including stamps, passports, and currency. In fact, a key is also required to activate the copier because the person who owns it is responsible for any illegal misuse.



FINE LINES: The detail of this aviation map comes through on the CJ10.

SCANNING AND PRINTING

The color copier is powerful and useful, but to get the full benefit you will want to hook the CJ10 up to your computer. This requires the Intelligent Processing Unit (IPU), a 3-inch-tall box that sits under the copier unit and adds another 15 pounds to the total system weight. It comes with 2MB of image memory, making it capable of printing images at the full 400-dpi 256-color resolution.

The IPU attaches to the copier via a video interface, and to your computer through a SCSI interface. The AT-bus version that we tested came with an Adaptec 16-bit SCSI interface card.

The interface kit comes with drivers for printing and scanning, and the install routine verifies the jumper settings for the interface card and tests the unit's print and scan functions. The only drivers included are for Windows 3.0 or later, but additional software includes a special subset of Aldus PhotoStyler, Version 1.1. The software lacks some advanced

features such as masking, JPEG compression, and color separation, but it does let you scan and edit color images.

Scanning and printing with the CJ10 can be quite a slow process. A full page can take several minutes to print, and scanning even a small portion of a page at 400 dpi with 256 colors can take 15 minutes or more. You can choose lower resolutions and fewer colors, which helps speed up performance considerably.

At the top resolutions, however, the output is worth the wait. On the special coated paper, the colors are strong and vivid. Copied text is not quite as good as laser printer output, but text printed from the computer is as good as you get from most lasers.

The print heads are integrated with the ink cartridges, and there is a purge-and-clean cycle to help keep the heads functioning properly.



GREAT COPY: The Canon CJ10 makes a color copy in 90 seconds for about 46 cents.

EASY SETUP

Setup and installation are fairly straightforward: Plug the components together, install the software and the interface card, configure Windows for the printer, and install PhotoStyler. The one hitch in this smooth sce-

nario is the fact that the documentation is a bit disjointed. There is one manual that covers the copier functions, with an appendix that briefly discusses the IPU. There is also a separate manual entitled *CJ10 Windows Utilities*, but this is the only source that provides clear instructions on how to install the interface card and connect the cables to the IPU.

One other problem with the documentation is the section on system requirements. While it is possible to run the unit on a 286-based system as described in the manual, the process is painfully slow. A fast 386SX would seem to make a much more reasonable minimum platform, and Canon even recommends a 25-MHz 386 or better.

PAPER LIMITATIONS

The system as a whole has some other limitations. The fact that it requires special (and expensive) coated paper is a drawback compared with other ink jet printers that can handle plain paper. And the fact that it cannot handle anything larger than letter-size sheets (such as legal or ledger size) limits the size of the image you can print. Canon does offer card stock, labels, and transparency sheets for the printer.

Paper handling is good, and the manual sheet feeder is an important extra touch. You do have to make sure, however, that you put the coated paper in the correct way. Images printed to the wrong side of the paper don't dry well.

The Canon CJ10 is versatile and powerful, with many features crammed into a single (albeit multipart) package. You could get much of the same functionality for a lower total price with separate products, such as the HP PaintJet XL300 color ink jet printer and the HP ScanJet IIc color scanner, but such an arrangement takes up more space and is certainly not as convenient. And if you need color copying capability as well, the CJ10 is your only one-stop solution. □

FACT FILE

Canon CJ10
Canon U.S.A. Inc., One Canon Plaza, Lake Success, NY 11042; 800-652-2666, 516-488-2666

List Price: Canon CJ10, \$6,995, SCSI IPU, \$2,700, AT-bus Windows kit, \$600; Micro Channel Windows kit, \$900
Requires: 4MB RAM, Windows 3.0 or later
In Short: A pricey but versatile color copier, scanner, and printer that produces outstanding letter-size output. It's slow, but the results are first-rate

 ON READER SERVICE CARD



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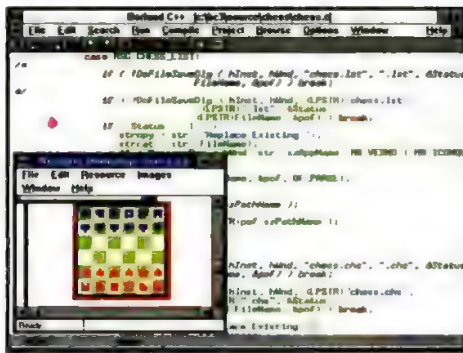
■ Languages

Borland Adds Full Windows Support to C++ Compiler

BY SHERYL CANTER

The compiler that so recently won our Editors' Choice award just got even better. Borland has two main points to make about Version 3.1 of its C++ compiler: It has full support for Windows 3.1, and its code optimization is much improved; Borland claims a 5 to 50 percent increase in code speed.

We put Borland C++ 3.1 through the same rigorous set of benchmark tests we used for our recent C/C++ compiler roundup (*PC Magazine*, July 1992), looking at C performance, C++ performance, and Windows performance. The most dramatic improvement we saw was in the area of C performance: C executable time was almost 40 percent faster than the previous version on our benchmark tests, making BC++



GET WITH THE PROGRAM: Borland C++ has an optimizing Windows-hosted compiler.

3.1 the fastest in this regard of any compiler we looked at—and by a very large margin.

The other major performance improvement in BC++ 3.1 is in the size of its C++ executables. In this case, the benchmark test results don't put BC++ 3.1 in the front of the pack, but they do show that Borland has corrected a notable weakness in Version 3.0. C++ executable sizes still aren't the

smallest, but they are no longer so strikingly large.

The only other C++ compiler on the market with support for the Windows 3.1 API (application programming interface) is Microsoft's own recently released C/C++, Version 7. It took Borland a scant two months to catch up. Not only does BC++ 3.1 provide full support for the new Windows features such as multimedia, pen computing, TrueType common dialogs, and OLE, but it also provides Borland's superior Windows development tools. Windows 3.0 is still fully supported as well.

FULLY OPTIMIZING COMPILER

While improved performance and Windows 3.1 API support are the big stories, there are a number of other important improvements as well. BC++ 3.1 provides the industry's first fully optimizing Windows-hosted C/C++ compiler. Version 3.0 came bundled with Turbo C++ for Windows, which has a Windows-hosted IDE (integrated development environment) but is not an optimizing compiler. Microsoft, ironically, does not have a Windows-hosted version of its C/C++ compiler.

There are many new sample programs to help you over the Windows 3.1 learning curve, and on-line help is available for Windows 3.0 and Windows 3.1 APIs from both the DOS- and Windows-hosted IDEs. Printed documentation for both APIs is now included as well.

Color syntax highlighting, which has been popular with Borland's entry-level products, has now been added to the professional compiler. You can color-code reserved words,

strings, and many other language elements. This lets you easily catch annoying bugs that can take hours to track down. If you like your code all in one color, you can set it up that way, too. Color highlighting is available in both the DOS and Windows-hosted IDEs.

One of the nicest features of Borland language products is the Project Manager, which takes the place of a MAKE file within the IDE. You need only list the files that make up your executable and the Project Manager takes care of the rest. Until Version 3.1, however, the Project Manager was not equipped to handle Windows resource files. Now you can include .RC

Borland C++, Version 3.1

Borland International Inc.,
1800 Green Hills Rd., Scotts
Valley, CA 95067; 800-874-
7233, 408-438-8400

List Price: \$495, upgrade, \$39.95

Requires: 15MB to 55MB hard disk space, DOS 3.1 or later, Microsoft Windows 3.0 or later, DOS development 640K RAM, 1MB extended memory, Windows development 640K RAM, 2MB extended memory

In Short: Borland's top-notch C++ compiler makes big performance gains and offers the industry's first fully optimizing Windows-hosted compiler

ON READER SERVICE CARD

files in your project; they will be automatically rebuilt and relinked if there is a change, just like other files in your project.

There are other enhancements as well. A new Windows tool, WinSpector, is a replacement for Microsoft's Dr. Watson that helps diagnose the reasons for Windows crashes. Unlike Dr. Watson, WinSpector understands Borland's debug information. Borland also claims stricter compliance to C++, C, and floating-point standards.

Borland C++ retails for \$495; the upgrade price is a mere \$39.95. If you own Version 3.0, you should upgrade. □

Benchmark Tests: Borland C++, Version 3.1

PC Magazine Labs tested C++ compilers on a Compaq Deskpro 386/25M with a 340MB hard disk and 8MB of RAM, 2MB of which was dedicated to a disk cache. We used XSCHME (a 10,000-line Lisp-like interpretive language) to test C performance, and CPBENCH (a 5,500-line program representative of real-life C++ applications) to test C++ performance. The results shown are for optimized tests only.

Borland C++ showed dramatic gains in C execution time, with Version 3.1 outperforming competitors by a wide margin. The other major improvement is that C++ executable files are smaller now, though not the smallest.

	MAKE Time (seconds)	Executable Size (bytes)	Execution Time (seconds)
C / DOS Performance			
Borland C++ 3.0	76.5	128,798	111
Borland C++ 3.1	82.1	129,070	70
Microsoft C++ 7.0	70.5	140,465	119
C++ / DOS Performance			
Borland C++ 3.0	38.8	97,995	67
Borland C++ 3.1	35.0	69,880	57
Microsoft C++ 7.0	42.0	57,374	37

Lower scores represent better performance.

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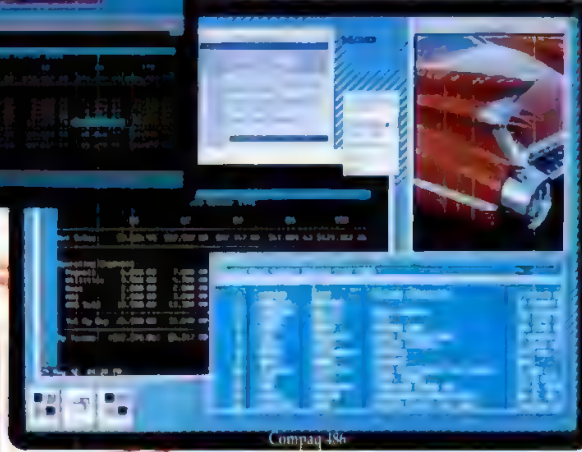
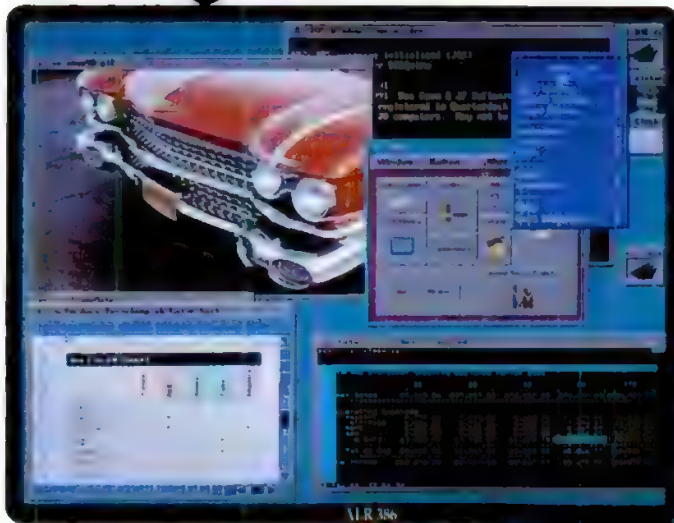
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CAD

AutoCAD 12: More Drawings In Less Time

BY JEFF PROSISE

When it set out to give its flagship CAD product a face-lift, Autodesk listened to its users. The result is AutoCAD, Release 12 (\$3,750), the easiest-to-use and most powerful AutoCAD to date, replete with features that make it equally useful for drawing simple floor plans or generating lifelike renderings of 3-D models.

The first change that veteran AutoCAD users will notice is that the main menu is gone. Release 12 boots up straight to the drawing screen. You then choose a drawing file by selecting Open from the drop-down File menu and highlighting a

you dynamically size the pick aperture. And for seamless integration of third-party software, you can create dialog boxes using AutoLISP or ADS (AutoCAD Development System).

One new feature that's sure to be a hit is the Plot Configuration dialog box, where you specify plot parameters without answering any prompts. Release 12 supports multiple plotting devices so you no longer have to reconfigure AutoCAD to select a different plotter, and stores up to 29 configurations. A Preview button displays plot previews, a long-awaited feature that will save time and paper by letting you see how a plot will fit onto the page.

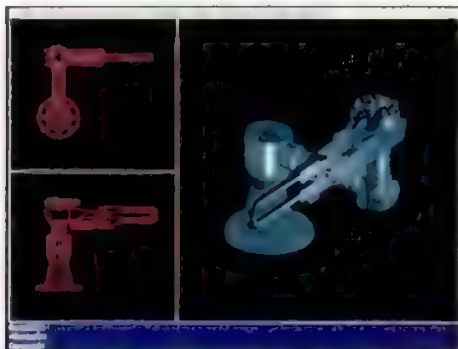
Another feature introduced in Release 12 is ASE (AutoCAD SQL Extension), an ADS application that forges a stronger link to external databases. ASE consists of a programming interface

that lets developers write one set of code to access dissimilar databases, and a user command set that permits users to store and access nongraphical drawing data in dBASE, Paradox, and other DBMS files.

For help in visualizing 3-D objects, Release 12 includes AutoCAD Render, a shading and rendering engine that supports 24-bit color imaging—the equivalent of AutoShade, Version 2, without RenderMan.

Plan to have lots of horsepower under the hood when you use it. A rendering like the one shown here can take two hours to produce on a 50-MHz 486 with 16MB of RAM, but the re-

tomatic timed saves; new filters to select entities based on user-specified criteria; and a pick-first option for picking drawing entities prior to specifying a command.



LIFELIKE: AutoCAD Release 12's Render feature supports 24-bit color.

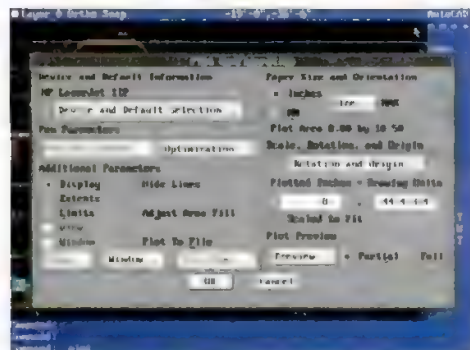
FASTER RESPONSE TIMES

None of these enhancements comes at the expense of speed. A new hidden line-removal algorithm speeds display of 3-D views with hidden lines removed by 5 to 100 times. New entity database search algorithms improve response times for entity selection and object snapping, and a new method of handling display data all but elimi-

nates the screen regenerations that impaired zooms and pans in earlier versions. The result is a faster, more responsive AutoCAD, though it still can't compete with packages such as FastCAD.

AutoCAD, Release 12, does not explicitly support Windows, but it runs with no apparent conflicts as a full-screen DOS application under Windows. For a true Windows environment, Autodesk's \$99 AutoCAD, Release 11, Extension for Windows is fully compatible with Release 12. Autodesk professes no plans to update Extension for Windows, but the company plans to introduce a 32-bit Windows version of AutoCAD in the near future.

Is AutoCAD, Release 12, a worthwhile investment? If you currently use an older version of the package, the answer is an unqualified yes. The new AutoCAD will help your company produce more drawings in less time. If you use another CAD package, or if you're shopping for your first, the answer is less clear. For more modest needs, check out some of the lesser-known CAD products that offer comparable 2-D feature sets for a fraction of the cost. But if a high-end package better suits your needs, AutoCAD Release 12 is definitely worth your consideration. □



PERFECT PLOT: New dialog boxes let you easily specify plot parameters and preview.

filename in a dialog box.

AutoCAD's user interface has been enhanced in other areas as well. Windows-like dialog boxes and cascading menus clearly present options, and all but eliminate the need to memorize arcane commands.

Select Object Snap from the Settings menu, for example, and you're presented with a dialog box containing check boxes for the 11 supported object snap modes and a scroll bar that lets

FACT FILE

AutoCAD, Release 12
Autodesk Inc., 2320 Marinship
Way, Sausalito, CA 94965;
800-445-5415, 415-332-2344;
fax, 415-491-8302

List Price: \$3,750, upgrade from AutoCAD, Release 11, \$500, upgrade from previous releases, \$500 (through Oct. 31, 1992)

Requires: 386 or 486 system with 387 or 487 math coprocessor (coprocessor not required on 486DX systems) 8MB RAM, 11MB hard disk space, DOS 3.3 or later, digitizing tablet or mouse.

In Short: The latest release of the industry's best-selling CAD product combines a reworked user interface, an expanded feature set, increased speed, better 3-D modeling, and an integrated rendering engine

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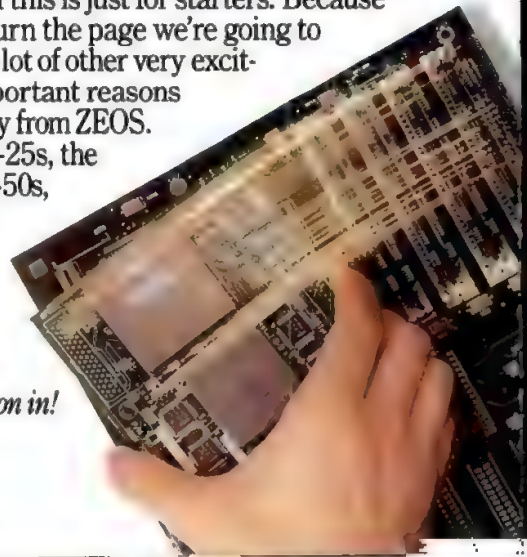
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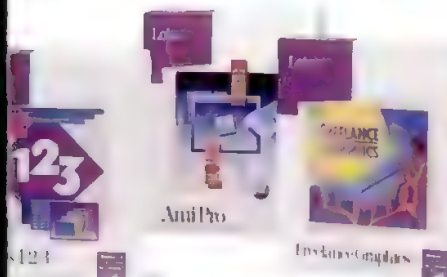
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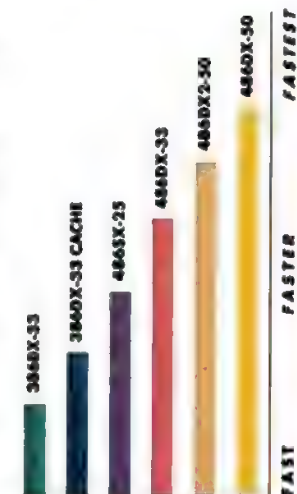
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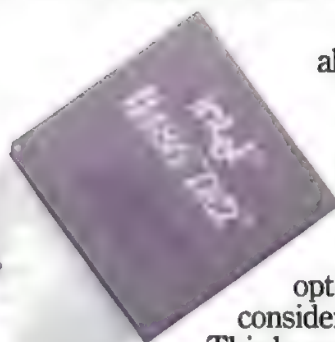
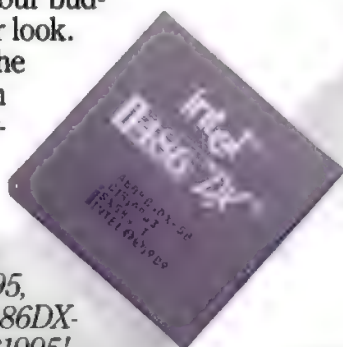
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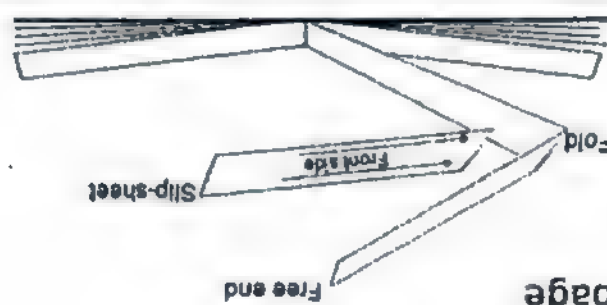
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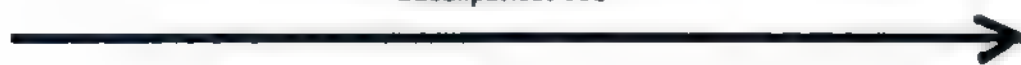


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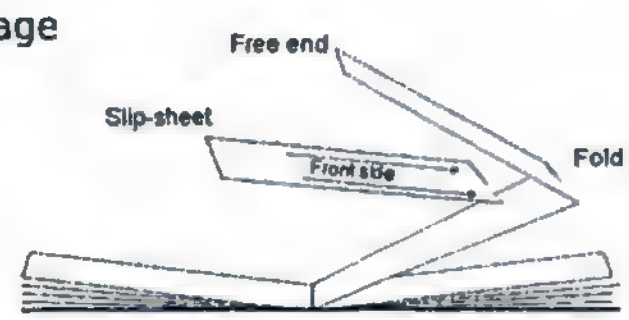
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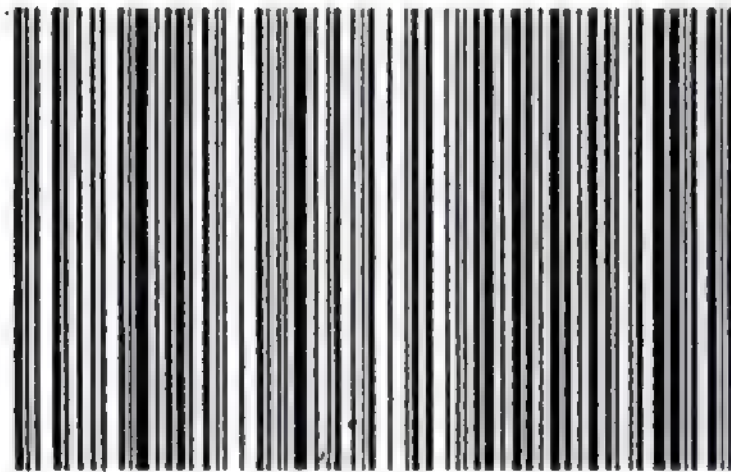
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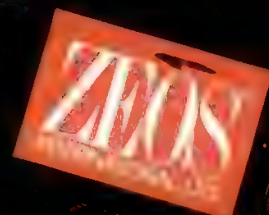


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■ Illustration

Professional Draw: Artistic Versatility

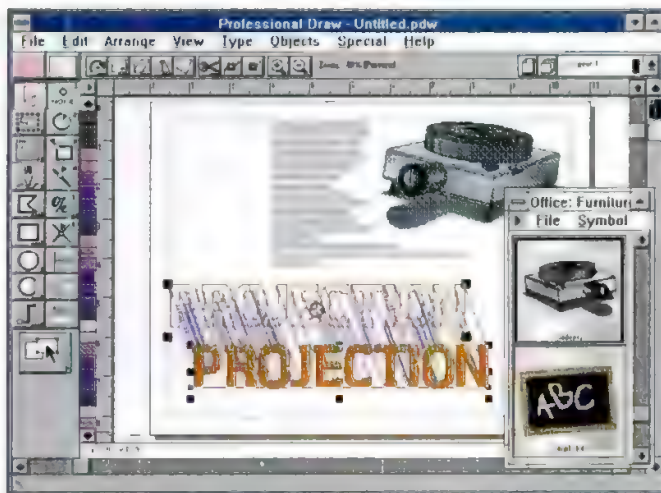
BY LUISA SIMONE

Gold Disk's Professional Draw may turn out to be the Swiss Army knife of graphics programs. This \$495 vector illustration program boasts tools for every conceivable application and for every level of user.

Professional Draw is primarily an illustration program, offering the basic scalable type, circles, rectangles, polygons, and Bezier curves. Like other drawing programs on the market, it allows you to combine, group, skew, rotate, mirror, and otherwise edit these simple shapes to create sophisticated drawings.

PUBLISHING AND PRESENTATIONS

Professional Draw is also suitable for creating short DTP documents. There are multiple pages per file and block text functions such as tracking, hyphenation, and spell-checking. Several high-powered features make dramatic layouts possible. You can wrap text around ir-



TOOLS GALORE: Professional Draw's toolbox contains not only drawing icons but powerful modifying functions as well.

regular polygons, link noncontiguous text blocks, and flow text into unusual shapes.

Though not intended to replace presentation graphics programs, the program allows you to choose 35-mm slides as a standard page size and access a page sorter to reorganize slide thumbnails.

Business and technical users who need quick organization or flowcharts will be thrilled with Professional Draw's dynamic connection lines and sockets that maintain the relationship between objects even when those objects move.

ILLUSTRATOR AT HEART

To understand the essential nature of Professional Draw, you must look at the drawing tools themselves. A cursory glance at the screen reveals only nine icons, but clicking and dragging any one produces a flyout with additional tools. For example, the straight-line tool can be replaced with the polygon, regular polygon/star, or gratings tool. If you double-click instead, you'll open up a dialog box where you

can configure the current tool.

Most impressively, a right mouse click reveals the drawing methods for each tool. There are six methods associated with drawing a rectangle, including corner-to-corner, center-to-corner, angled, and sheared.

To tap Professional Draw's

about every drawing feature you could possibly want. It ships with 1,000 pieces of clip art and 150 Type 1 fonts (it supports but doesn't ship TrueType fonts). The practical layer manager, named styles for object attributes, multicolor gradient fills, and true masks just skim the surface. There are also high-end functions for organizing and compressing images and for color separations, including GCR (gray-component replacement) and trapping.

Professional Draw's unique color-control features are impressive. Converting colors to gray scale or changing the brightness and contrast worked equally well on vector and bitmapped images.

The only major problem we encountered during testing concerned extrusions. The program has trouble with sharply mitered objects (like the pointy capital A in the Times Roman alphabet). Instead of a logical 3-D effect, Professional Draw created aberrant shapes. Another performance problem was clearly memory-related. If you plan on producing complex multiple-page documents, you'll need considerably more memory than the 2MB minimum.

Professional Draw isn't perfect. It should support calligraphic line styles and control the orientation of text along a curve. And there are gaps in its file support. It handles standard file formats (such as EPS, PCX, and TIFF) but can only import—not export—CGM files.

Perhaps the weakest link is the one that binds it to an ancillary tracing program. Though slow, it does a fine job tracing black-and-white or high-contrast bitmaps. But its attempts to trace 8- and 24-bit images were simply not acceptable.

Professional Draw has something for everyone. Business users will appreciate a full-featured drawing program that's \$100 to \$200 cheaper than the competition. And professional artists will find a multitude of functions that are simply not offered in other programs. □

real power, though, you must use the editing and alignment tools. The program supplements the standard alignment and snap functions with Modifiers that literally change the way the drawing tools work. If you want to create a series of lines radiating from the center of a circle, you simply use the Snap-to-Center modifier to start each line at the circle's midpoint. Used in combination with the drawing methods, Modifiers are wondrously powerful.

EASY SPECIAL EFFECTS

Professional Draw addresses the needs of novice users by providing powerful special effects that are incredibly easy to master. Aligning text along a curve is as simple as choosing one of the six methods for the Text Effects tool. On a more sophisticated note, Professional Draw is the only new program on the market that rivals CorelDRAW and Arts and Letters Editor with automated effects such as blends, enveloping, and extrusions.

The package includes just

▶ FACT FILE

Professional Draw, Version 1.0

Gold Disk Inc., 5155 Spectrum
Way, Unit 5, Mississauga,
Ontario, Canada L4W5A1;
800-465-3375, 416-602-4000;
fax, 416-602-4001

List Price: \$495, upgrade from a competing package, \$129

Requires: 2MB RAM, 5MB hard disk space, Windows 3.0 or later

In Short: Professional Draw goes head-to-head with competing illustration programs by providing an exhaustive list of features. The complexity of the tools—and how they interact—is offset by truly easy-to-use special effects

ON READER SERVICE CARD

■ Accounting

DacEasy Instant: DOS and Windows Accounting Software in One Box for \$50

BY THERESA W. CAREY

The cutthroat competition at the low end of the accounting software market continues. A new competitor, DacEasy Instant Accounting (\$49.95), has accounting features you'd expect from a more expensive package.

First you'll notice that you can run Instant Accounting as a Windows or DOS application: Both versions are in the box. The DOS version looks exactly like the Windows version, so the transition from one to the other isn't difficult.

The program is designed for the accounting-phobic small-business owner. Unless you go into the General Ledger module, you are shielded from the words "debit" and "credit." The Bank module updates the General Ledger for each transaction without your intervention.

Instant Accounting lets you customize invoices and statements so that you're not forced to use expensive preprinted

forms. The program can display your company logo on the Windows invoice form if the logo is stored as a bitmap.

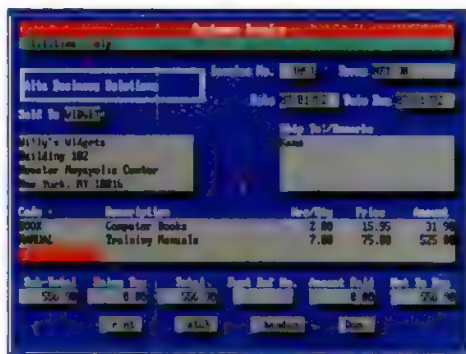
Helpful contact-management routines for customers and vendors are built-in. You can write letters, send faxes, track phone calls, perform mail merges, and print labels. With a

modem, you can also use the Customer or Vendor ledgers to dial the phone.

Working with the program is relatively easy, if you start with a balanced set of books. The manual is effective at guiding you through setup and giving you clear explanations.

Instant Accounting updates files immediately, except for invoices. Transactions are reflected in General Ledger accounts, but you still have to post invoices so that they show up in your reports. There are a number of predefined reports, and it's possible to customize your balance sheet and income statement. Report customization is limited.

DacEasy has positioned this product to compete with other



BALANCING ACT: DacEasy Instant offers relief for accounting-phobic small-businesses.

■ Video

LaptopTV: Idiot-Proof VGA-to-TV Conversion

BY ROBERT KENDALL

Computers are great for fashioning elaborate presentations, but multimedia systems and large-screen monitors aren't easy to lug around to show off your work.

Willow Peripherals' \$1,195 LaptopTV box is one of the best and simplest means for converting your PC's VGA output into a high-quality NTSC (National Television Standards Committee) signal that can be displayed on any television or stored on videotape.

Since an NTSC signal is interlaced, it's impossible to wrest from it a picture as clear as the original VGA image. The LaptopTV achieves a remarkably stable NTSC image, though, and reduces flicker to an almost imperceptible minimum. This is pos-

sible because unlike many other scan converters, it digitizes the VGA input during conversion. The picture quality is equal to that of much more expensive competitors such as VideoLogic's Mediator.

The LaptopTV will not con-

genlocking and overlay to let you add titles or graphics to existing videotapes.

This 2.5-pound external unit is about the size of a notebook PC, though it requires a bulky power adapter. Setup is nearly effortless. You connect it to your VGA card with a supplied cable and connect a VGA monitor to another port.

As with most converters, the top and bottom will be cut off of a converted 640-by-480 VGA

image. Willow provides VGA drivers that let you run Windows at resolutions of 640-by-440 or 640-by-420 for a perfect fit on our NTSC test display.

The LaptopTV is a top-notch, nearly idiot-proof tool for turning presentations into top-quality videotapes. And portability makes it a great adjunct for the traveling presenter.

• List Price: LaptopTV, \$1,195. Requires: VGA display, NTSC monitor or TV. Willow Peripherals, 190 Willow Ave., Bronx, NY 10454; 800-444-1585, 212-402-9500; fax, 212-402-9603.

Circle 402 on reader service card



TRAVELING ACT: LaptopTV converts presentations for television viewing.

vert from VGA resolutions above 640-by-480, which is about the same as NTSC video resolution. It can handle color depths up to 24 bits. Unlike many VGA-to-NTSC boards, the LaptopTV does not perform

small-business accounting packages such as QuickBooks (First Looks, July 1992). Though upgrading to Instant Accounting from a financial planning program like Quicken seems natural, there is no way to convert the files. You can upgrade from DacEasy Lite by requesting a conversion program.

If you're choosing between Instant Accounting and QuickBooks, consider the price difference (\$49.95 versus \$139.95) and the dual platform. Both require a separate payroll package, and QuickBooks lacks the contact-management capabilities of Instant Accounting, though it does include a few more report formats.

For relatively easy entry-level accounting and contact management at a price you can afford, Instant Accounting stands out in a growing crowd.

• List Price: DacEasy Instant Accounting, \$49.95. Requires: 512K RAM, 1.5MB hard disk space, DOS 3.1 or later. Windows version requires 1MB RAM, 2MB hard disk space, Windows 3.0 or later. DacEasy Inc., 17950 Preston Rd., #800, Dallas, TX 75252; 800-322-3279, 214-248-0205; fax, 214-250-3752.

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B O R L A N D
Software Craftsmanship

■ Application Development

Windowcraft: HyperCard-Like Environment For the Do-It-Yourself Developer

BY STEVE ROSENTHAL

Windowcraft has the potential to be the all-purpose cardfile, presentation program, friendly custom front-end, and intelligent database for Windows that HyperCard is for the Macintosh, but users of this initial release will need ingenuity and patience. While the \$295 program shows plenty of promise, Version 1.0 is plagued by some annoying rough spots.

Like Asymetrix Corp.'s Toolbook and Spinnaker Software Corp.'s Spinnaker PLUS, Windowcraft is object-oriented. You can quickly construct an interactive application using a combination of on-screen buttons, fields, and graphics. Presentations can include collections of different screen images or, like a card-style database, applications can repeat a single image but display different data in each instance. You can also mix both styles in order to build interactive kiosks, computer-aided instruction, and executive information systems.

As with other programs of this genre, the screens, menus, and windows that make up the visible part of each application are just a start. If you want to customize the action of each object and menu, you can use Windowcraft's extensive English-like scripting language. Scripts are activated by mouse clicks or keystrokes, by changes in parent objects, or by messages from other scripts.

EASIER THAN TOOLBOX

Windowcraft is about as powerful as Toolbook, but it is easier to use and is better at locating and sorting information and redrawing graphic screens. The

Windowcraft program also offers better support for 256-color graphics. You can import and edit full 8-bit graphics and pick working color selections from the full 24-bit color space, a feature that is particularly important for making really good-

looking graphical applications.

It also earns high marks as a cooperative application. You can define links to Windows DLLs (dynamic link libraries) for special functions such as multimedia sound or video or mainframe links, and build

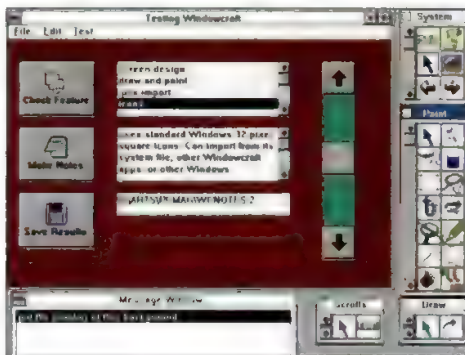
DDE (dynamic data exchange) connections to and from other programs. There's even an import function for dBASE III and IV files and a combination Macintosh stack and import function for importing HyperCard stacks.

Moreover, once you have built a useful program, you can turn all these functions into standalone applications that you can distribute to

other Windows users. Windowcraft will compile any of its applications into a standard Windows .EXE file that needs only the runtime DLL you get for free distribution when you register your copy of the full program.

Unfortunately, all of this power takes some taming. A few of Windowcraft's functions, such as the on-screen prompt box, are still unfinished, and even a simple transfer from one Windowcraft file to another can leave the program hopelessly tangled in its own windows. Though it constitutes an admirable effort at a Windows development tool, Windowcraft requires that you have patience for making backups and finding workarounds.

• **List Price:** Windowcraft, \$295. **Requires:** 2.5MB RAM, Microsoft Windows 3.0 or later. Windowcraft Corp., 6 New England Executive Park, Burlington, MA 01803; 800-828-2268, 617-272-0999; fax, 617-273-0749. Circle 431 on reader service card



ROLL YOUR OWN: Windowcraft makes it easy to create interactive applications.

■ Multimedia

ArtiSound Gives Your Windows Apps a Voice

BY STEVE RIGNEY

Ever wish that your spreadsheet could explain expenditures to you—in words? Or that your e-mail messages could speak? How about narrating a presentation without even being in the room?

The Artisoft Sounding Board and ArtiSound Recorder package lets you record digitized voice messages and sounds, embed them in applications, and play them back. It costs \$99 for the ISA package; \$199 for the MCA package.

The package includes the award-winning Artisoft Sounding Board (an 8-bit adapter that digitizes sound and saves recorded voice or sound to disk); a telephone-style handset that provides excellent sound clarity; audio-in and audio-out jacks for

connecting the sound board to CD players, tape recorders, and amplifiers; and the ArtiSound Recorder software.

The ArtiSound Recorder is essentially an OLE (Object Linking and Embedding) server that allows you to record a message or sound and cut and paste its icon where you want it in the Windows application. The package records sound from a variety of sources and plays prerecorded sound files in Windows .WAV (waveform audio files) and .PCM (pulse code modulation) formats.

When someone views the file and clicks on the icon, ArtiSound replays the recorded message. To take advantage of OLE support, you must run Microsoft Windows, Version 3.1, or add Multimedia Extensions to your Windows 3.0 application.

The ArtiSound software will also work with Creative Labs' SoundBlaster board.

The drawback to digitizing sound is the resulting large files, in this case about 8K per second of recorded sound (480K per minute). Fortunately, Artisoft's LANtastic network OS can compress the files 2:1.

ArtiSound's relatively low price tag and its support for OLE, LANtastic, electronic mail programs, and a variety of audio file formats makes it a practical way to get your feet wet in multimedia. Plus, you'll find the effect of sound in your presentations, documents, and e-mail to be dramatic.

• **List Price:** Artisoft Sounding Board and ArtiSound Recorder, Standard ISA Bus, \$99; MCA bus, \$199. **Requires:** 8-bit slot, Microsoft Windows 3.0 with Multimedia Extensions or Microsoft Windows 3.1. Artisoft Inc., 691 East River Rd., Tucson, AZ 85704; 602-293-4000; fax, 602-293-8065.

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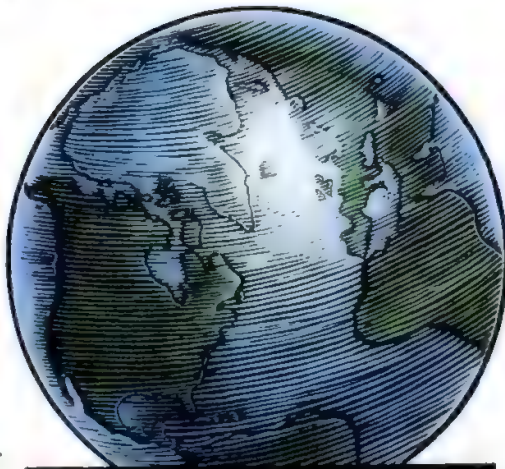
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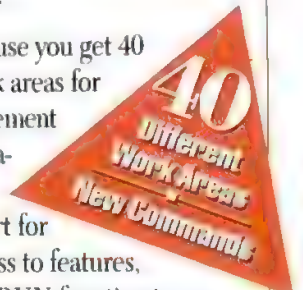
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■ Scanners

Ofoto and New Apple One-Scanner for Windows Pack One-Two Gray-Scale Punch

BY LORI GRUNIN

When a company brings a Macintosh graphics product over to the DOS-based world, it's usually a big deal, and what deal could be bigger than Apple bringing over one of its own? At \$1,299, Apple's OneScanner for Windows is priced competitively with Hewlett-Packard's ScanJet IIp and provides better quality scans at the same 300-dot-per-inch resolution.

The OneScanner for Windows is essentially the same unit that's been shipping for the Mac. The "for Windows" element is an Adaptec AHA-1510 16-bit SCSI card with a too-short cable, and utility software that runs under Windows. Two SCSI connectors on the back of the OneScanner allow for daisy chaining with compatible SCSI-based peripherals.

Minimalist indicators on the front left of the OneScanner—a ready light and a scan-in-progress light—alert to a bare minimum of error conditions. The light bulb replacement scheme is especially clever, however: You open a panel in the side of the unit and slide out a carrier, replace the bulb, then slide it back in. As a consequence of using a green fluorescent bulb, the scanner's dropout color (the color it will fail to pick up) is green.

THE SOFTWARE IS THE STORY

Although the OneScanner has a great design, its real edge stems

from Ofoto for Windows, a highly regarded Macintosh-based scanning software utility from Light Source that the company has ported for use under Windows. It comes bundled

out a calibration sheet that you can then scan back in and save. This is a handy way to calibrate when you print from other applications, such as PageMaker. There's also an uncalibrated, raw data option.

In addition to specifying spatial and gray-scale resolution in the calibration file—including separate gray-scale and line-art resolutions—Ofoto lets you specify highlight and shadow dot percentages for the output device.

When you scan

FLATBED PRESTIGE: Apple lends its graphical talents to the PC with the \$1,299 OneScanner for Windows.

with the OneScanner unit. (A limited-use trial version of Caere's OmniPage Professional optical character recognition software also comes in the box.) In addition to the Apple OneScanner bundle, Light Source sells a \$395 standalone version of the Ofoto software that comes with drivers for a variety of Abaton, Hewlett-Packard, and Microtek scanners, both color and gray-scale, as well as the Epson ES-300C.

Ofoto's *raison d'être* is creating an idiot-proof environment for scanning images intended for chosen output devices. It achieves its goal through the use of predefined calibration settings for the HP LaserJet (both PCL and PostScript), DeskJets and PaintJet, the Apple LaserWriters, the Linotronic 300, fax, and screen. If you'd like to tie your input and output device calibrations more closely together, Ofoto lets you print

blessing and a curse; while it allows you to print to a variety of output devices without affecting the underlying image, you do end up with an infestation of these companion files on your hard disk.

CLICK AND GO

The other method that Ofoto uses to streamline the scanning process is AutoScanning, which automatically finds the source image on the scanned, determines its type (gray-scale or line-art), then scans and straightens it. The product also has a clever Straighten Tool, a grid placed over the image that allows you to rotate the image in alignment with some element within it. This tool was also the one element of Ofoto that was difficult to figure out without referring to the excellent documentation.

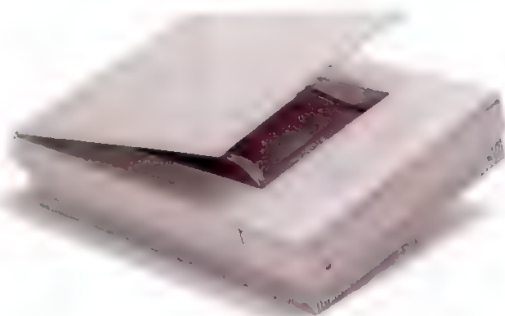
Ofoto's best trick, geared as much toward higher-quality images as making the product easier to use, is the way the software handles post-processing. It remembers the changes you

make after scanning; when you rescan, Ofoto then applies them in the order that degrades the image the least. So, if you crop an image, rotate it, and then scale it 200 percent, Ofoto will scan at 200 percent, rotate it, and then crop it.

This method also lets you perform similar operations on a series of images, and perfect alterations while working on a low-resolution scan before performing them on a high-resolution one.

In testing, the system worked flawlessly. The tonal range of the Ofoto/

Apple combination tended to be slightly broader than that of the HP IIp with either Ofoto or DeskScan II (the utility bundled with HP scanners). The result was strikingly good gray-scale images, even when printed on a LaserJet. In addition, the OneScanner did very well on line art and text, with good



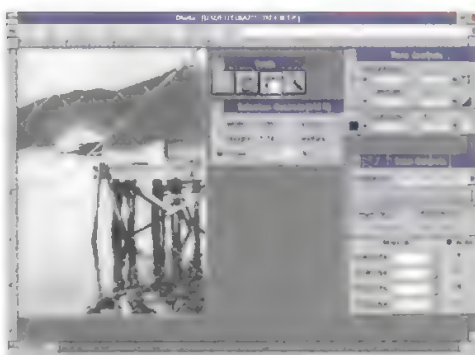
SUPER SCAN: The Ofoto/OneScanner combination delivers excellent gray-scale output on a broad range of devices.

using a calibration file, Ofoto tracks which file you used by creating a small (790-byte) companion file for the output image. This method can be both a

resolvability even on small point sizes.

FLAWED DIAMONDS

Although there's a lot to like about this bundle, there's a bit to dislike as well. Installation of the OneScanner isn't the plug-and-play procedure that it should be; if your PC has recessed slots (so that the connectors are not even with the back of the chassis), keeping the clamps on the adapter from getting caught on the overhanging lip can be frustrating. In addition, the 4-by-14-by-22-inch



GRIDLOCK: The grid used by Ofoto's Straighten Tool lets you rotate an image precisely.

(HWD) OneScanner also seems like an elephant compared with the diminutive ScanJet IIP, al-

though the Apple can handle up to legal-size paper, compared with the HP's letter-size limit.

Ofoto isn't perfect. In its attempt to shield you from the realities of image processing, it lacks a way to correct the *gamma*—the balance of the highlights, midtones, and shadows—of an image manually. This yields unpredictable results when scanning for the screen and results in an unwieldy custom-calibration process.

Still, the OneScanner/Ofoto duo is hard to beat. Ofoto alone

is a bit high-priced, but it delivers super output.

• **List Price:** *Apple OneScanner for Windows*, \$1,299 (including *Ofoto for Windows*). *Apple Computer Corp.*, 20525 Mariani Ave., Cupertino, CA 95014; 800-776-2333, 408-996-1010.

Circle 405 on reader service card

• **List Price:** *Ofoto for Windows, Version 1.0*, \$395. Requires: 2MB RAM, 10MB hard disk space, VGA adapter or better, Windows 3.0 or later. *Light Source, Inc.*, 17 E. Sir Francis Drake Blvd., #100, Larkspur, CA 94939; 415-461-8011.

Circle 406 on reader service card

■ Contact Management

Act for Windows: Top-Notch Contact Manager Gets Graphical Make-Over

BY GREGG KEIZER

Try to deal with the details of daily business on your own, relying solely on memory and scribbled notes, and you're inviting disaster. Too much can fall through the cracks.

Contact Software's Act, the holder of a *PC Magazine* Editors' Choice award, applies your PC's elephantine memory to the problem. Its specialized database remembers the details, then provides the tools you need to stay in touch with others. Act for Windows (\$495) retains almost all the features of its DOS forebear, but bundles them in a more attractive and much more functional package.

The basic features haven't changed. Two screens contain as many as 70 data fields for each contact; multiple meetings, tasks, and calls attach to specific contacts; and completed activities automatically log in a time and date. There's a middle-weight word processor and a notepad that date-stamps entries attached to each contact. Customizable lists can appear with any field for faster and precise data entry. Act also dials

phone numbers. The only component not ported over from DOS is the expense module.

GRAPHICAL SCHEDULING

Act for Windows departs most dramatically from the DOS version in the way you can enter and view calls, meetings, and tasks. Unlike the rough charts in the DOS version, Act for Windows assembles graphical daily, weekly, and monthly calendar views. A quick glance tells when you're booked up or when a project is due. Scheduling is just as easy. To note the date of a meeting, click the day on a miniature calendar, then click a quarter-hour segment on the daily time sheet. Rescheduling is as easy as dragging and dropping an activity onto another day or time.

Windows plays a smaller role in Act's word processor, an underpowered graphical writing tool that lacks such amenities as shortcut keys. More distressing, it can only import data in text or .RTF formats, making it difficult for you to import letters from

the DOS version of Act. However, it does support DDE (dynamic data exchange) as a source, so you can link Act fields to documents from DDE-compliant applications.

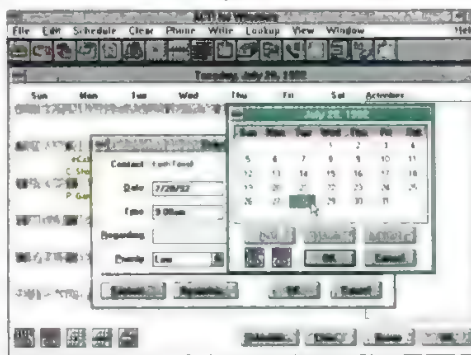
Both queries and reports are easy to build by pointing and clicking to select contacts. Act for Windows comes with a number of predesigned report formats that highlight contacts and contact history. You can also construct your own formats and add them to the menu or icon toolbar. Another nice touch is on-screen reports that match

DOS version, so even when a network Windows version is available, DOS users can't share contact databases with Windows users on a network.

The price you pay for all the graphical convenience is slowness as the program searches for contacts, swaps screens, and conducts queries. While the DOS version snaps right to a contact, Act for Windows hesitates. And the program has a voracious appetite for Windows' system resources, consuming nearly twice as much as Word for Windows demands. Clearly,

Act for Windows is a poor choice as a portable contact manager; Contact's 1st Act is much better on the road.

As a desktop contact manager, though, Act for Windows has no peers. Its schedule management is second to none, and its core contact database and tools come to Windows ready to work. Act for Windows is a first-class way to keep everything on the table, not down



BOOKED UP: Act for Windows will win hearts and minds with its slick scheduling.

their printed counterparts.

If you're using the DOS-based Act, you can transfer its data intact to Act for Windows. It will also open files from the as-yet-unreleased Macintosh version. One note of caution: Act for Windows' .DBF file format is not directly compatible with the file format of Act's

in the cracks.

• **List Price:** *Act for Windows, Version 1.0*; \$495. Requires: 2MB RAM, 2MB hard disk space, Windows 3.0 or later. *Contact Software International*, 1840 Hutton Dr., #200, Carrollton, TX 75006; 800-365-0606, 214-919-9500; fax, 214-919-9750

Circle 407 on reader service card

■ Windows Utilities

Metz Task Manager Simplifies The Windows Shell Game

BY BARRY SIMON

You know you need a Windows shell when you start to think about everything you wish you could do in Windows but can't. Some shells introduce entirely new ways of working under Windows, but if you'd rather not commit to radically new ideas, then a more modest shell may be all you need.

No other Windows utility packs more functionality per square pixel than the \$49.95 Metz Task Manager. Hit Ctrl-Esc or double-click on the desktop and up pops a window that takes up about 35 percent of a screen. Inside is a task list; access to program launching; a quick launch pad; a run box with a history list; date, time, free memory, and resources; quick access to file-management functions (copy, move, rename, delete, print, file find, text search); a system report; and buttons to

arrange, minimize, and close tasks. The miracle is that Metz Task Manager looks uncluttered rather than messy while providing all these tools.

There are trade-offs when you replace Windows' Program Manager. For example, Metz cannot use the launch icon for a DOS program after it has been minimized on the desktop. But all the functionality of Windows' Task Manager is subsumed under Metz. To switch to an active task that is displayed on the Metz Task List, just double-click as you would normally.

As a superset of Windows' Task Manager, Metz offers much more. For example, you can select several items on the Task List and drag them over to the End Task button. You can also display hidden tasks, full



DESKTOP DIRECTOR: Metz Task Manager groups loads of functions in one window.

pathnames, and icons.

Above the Task List is a drop-down list of your Program Manager groups. Select one of them, and the Task List changes to the list of programs in that group. To launch a program, double-click on it or select either the launch normal or launch minimized buttons. You can also launch multiple programs at once.

Metz provides a user-configurable launch pad that holds nine items. To configure it, just drag nine of the items you use most frequently over to the pad and drop each on a blank button.

If you don't like fooling with your setup, you'll be pleasantly surprised by Metz's easy configuration. But if you like to customize, right click on one of the launch buttons to bring up a dialog box. You can also set up a multiple-level launch menu from Task Manager's menu bar.

Metz always displays the most important system status information—free resources and memory. A button invokes a panel with additional information. Its quick file tools aren't sophisticated; there is no Boolean search option and no attribute changer in the file manager, but they load quickly and from anywhere with a few mouse clicks.

Among the little extras you'll get with Metz is the ability to bypass Windows' Control Panel and directly select a printer. Another menu item lets you change the Windows shell without explicitly editing your WIN.INI file. There is also a screen blanker and a scheduler.

With all its superb features, Metz does have some minor flaws. Its DOS hotkey support is awkward and flawed, since it passes the keystrokes through to the DOS application. Also, the launch pad configuration dialog does not offer a way to change icons.

Metz Task Manager is a substantial upgrade to the version that won an Editors' Choice in our Windows utilities roundup (February 26, 1991). It makes the lowly Task Manager fly.

• **List Price:** Metz Task Manager, Version 2.0, \$49.95; upgrade, \$19.95. Requires: Windows 3.0 or later. Metz Software, P.O. Box 6699, Bellevue, WA 98008; 800-447-1712, 206-641-4525; fax, 206-644-6026.

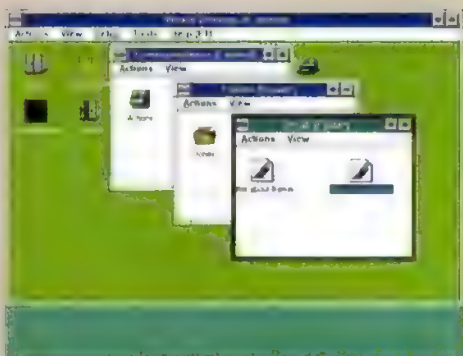
Circle 403 on reader service card

■ DEC's Vivace: A NewWave Competitor

You can spot the Windows shells that consider object orientation a religion by their first drop-down menu. If it's called "Actions" instead of "File," as is the case in Digital Equipment Corp.'s new \$145 Vivace and Hewlett-Packard's NewWave, expect the unexpected to follow.

Vivace hides the DOS file system by using Cabinets, Drawers, and Folders. You can give filenames up to 24 characters long, but the underlying DOS name and directory aren't evident. That's not a problem if you'll access files only through Vivace, but if you want to open multiple files in a program like Word for Windows, you may run into trouble.

Without NewWave's Agent and compound documents, Vivace lacks its competitor's depth. But if you like the idea of hiding DOS's file system with an object layer and don't want to deal with NewWave's complexity, Vivace is an option.—BS



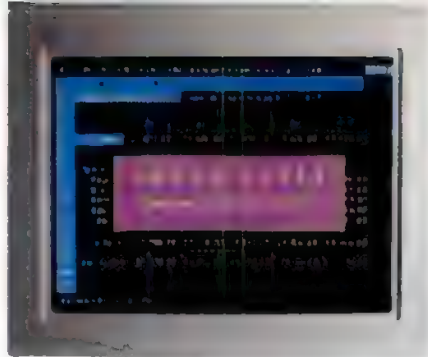
ACTIONS: DEC's Vivace brings object orientation to Windows.

• **List Price:** Vivace for Windows, Version 1.0, \$145. Requires: Windows 3.0 or later. Digital Equipment Corp., 305 Foster St., Littleton, MA 01460; 800-272-2001, 508-841-7226.

Circle 404 on reader service card



Ambulance Car Virus. Ambulance randomly moves across bottom of display.



Friday 13th Virus. Alias "Black Friday." Erases programs when you try to run them.



Disk Killer Virus. Alias "Ogre." Causes unexpected formatting of your hard disk.



Stoned Virus. Alias "Hawaii." Data loss caused by damage to directory and FAT.



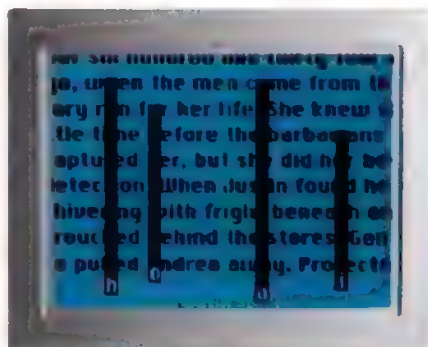
Datacrime Virus. Adds garbage to files and reformats disk.



AirCop Virus. Alias "Red State." Attacks boot sector on non-write-protected diskettes.



Ping Pong Virus. Alias "Bouncing Ball." Wipes characters off the screen.



Falling Letters Virus. Characters fall to the bottom of the monitor. Creative, but a real nuisance.



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Central Point Anti-Virus offers both Windows and

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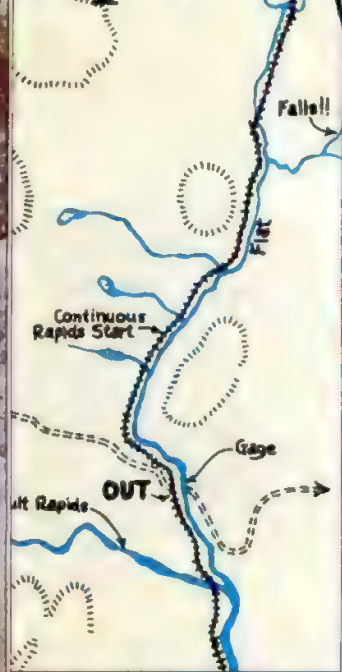
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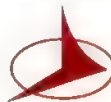
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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Emerson Andrew Torgan

NEW

Dell Takes Aim at Compaq with New Dimension Line of Systems

Dell's first salvo at Compaq's ProLinea line of affordable PCs consists of ten well-aimed shots. Dell's Dimension line (five desktop, three server, and two notebook PCs) are priced between 17 and 34 percent below ProLinea systems of comparable configurations.

The lowest-priced member of the Dimension line is the 386SX/25 (\$1,259). The system ships in standard configuration with 2MB of RAM, an 80MB hard disk, two floppy disk drives, a SuperVGA color monitor, DOS 5.0 and Windows 3.1 preinstalled, three drive bays and four expansion slots, and a mouse. The most expensive Dimension PC is the 486DX2/50 (\$2,799), a floor-standing tower model with 8MB of RAM, a 212MB hard disk, two floppy disk drives, an UltraVGA color monitor, DOS 5.0 and Windows 3.1 preinstalled, six drive bays, six expansion slots, and a mouse. Also included in the Dimension line are the NL20 and NL25 notebook PCs, which were previously introduced.



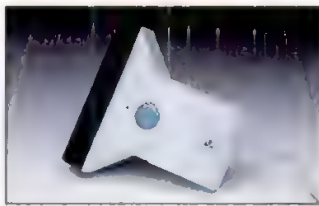
Dell's new \$2,099 Dimension 486DX/33.

Dimension systems carry Dell's toll-free, automated technical support; one-year access to the Dimension expert hotline; 24-hour-a-day TechFax services; one year of second-business-day on-site service; and a 30-day money-back guarantee.

- List Price: 386SX/25 (basic configuration), \$1,259; 486DX2/50 tower model, \$2,799. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 512-338-8700.

Circle 410 on reader service card

HOT PROSPECT



Logitech's Breakthrough! 24-Bit Color Hand Scanner

Imagine 16.8 million colors—in the palm of your hand. Logitech has unveiled the ScanMan Color, a \$699, 24-color hand scanner for Windows that uses a proprietary white fluorescent light for consistent brightness and requires no warm-up period. Bundled with the unit is Logitech's FotoTouch Color image-editing software, featuring AutoStitch capabilities to provide virtual page scanning. AutoStitch lets users merge multiple scans automatically. The software also "deskews" each scan, pinpoints matching features, extrapolates to fill in missing pixels, and calibrates color across the finished image. FotoTouch Color offers a variety of image-editing tools, and slider controls for such adjustments as brightness, contrast, color balance, and tonality.

To ensure that display and output are consistent with the colors of the original image, FotoTouch Color now provides "total system calibration." Users calibrate monitor colors by matching a black-and-white checkerboard pattern with computer-rendered gray. To calibrate a printer, the software sends a graded color strip to the printer. The strip is then scanned back into FotoTouch for comparison. The ScanMan Color Hand Scanner supports the TWAIN image-acquisition application programming interface (API).

- List Price: ScanMan Color, \$699. Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500; fax, 510-792-8901.

Circle 409 on reader service card

IMPROVED

Gold Disk Ships New AWI, Offers MCI Drivers Free

Gold Disk has unveiled Animation Works Interactive, Version 1.1, with a new acceleration capability that speeds movie playback and streams data from the hard disk to produce smoother presentations. Gold Disk is also licensing its new MCI animation drivers and runtime player free of charge to software developers, multimedia application developers, and corporate users, according to the company.

Animation Works Interactive's MCI animation drivers let users play back movies from within many Windows applications using Windows' standard MCI commands. The update offers DVI (Digital Video Interactive) support and more than 100 clip animations, clip-art files, sound effects, and music clips that enhance the package's existing libraries. Animation Works Interactive, Version 1.1, also sports optimized compression ratios, and new support for the .TIF, .TGA, and .CGM graphics file formats.

- List Price: Animation Works Interactive, Version 1.1, \$495; free to registered users of Version 1.0. Gold Disk Inc., 5155 Spectrum Way, Unit 5, Mississauga, Ontario, Canada, L4W 5A1; 416-602-4000; fax, 416-602-4001.

Circle 411 on reader service card

NEW

Lotus's SmartPak: Enhancement Package or Bug Fix?

Lotus is shipping SmartPak for 1-2-3 for Windows free of charge to current users of 1-2-3 for Windows. The enhancement package, which includes SmartIcons, GUI application development tools, the Lotus Dialog Editor (for flexible dialog-box creation), and a host of new features, will be provided in all new units of Lotus 1-2-3 for Windows, Version 1.1, according to the company.

SmartPak for 1-2-3 for Windows features include Smartfill, for automatically populating a spreadsheet range with commonly used data series; CrossTabs, for creating a summary table from database information; SmartFormat, for cycling through up to ten predefined formats; and a new SmartIcon for printing graphs in portrait or landscape mode. The new Application development tools include GUI macro key-

New & Improved

words that can replace 1-2-3 menus with custom application menus. SmartPak for 1-2-3 for Windows is available directly from Lotus by calling 800-872-3387 or in the Lotus forum on CompuServe.

• **List Price:** *SmartPak for 1-2-3 for Windows*, free to registered users of Lotus 1-2-3 for Windows. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500.

Circle 412 on reader service card

IMPROVED

ZyIndex 5.0: A Unique Concept in Document Retrieval

ZyLab has unveiled ZyIndex, Version 5.0, its document retrieval software for Windows. In addition to speeding the retrieval process, the new version features the concept of creating InfoApps (Information Applications) by interconnecting documents with hyperlinks and attaching notes to text and graphics images. The notes can be added to any word or section of a document and can be designated for either public or private viewing.

ZyIndex 5.0 provides users with an automated index creation feature, the ability to search multiple indexes, and an application-launching capability.

• **List Price:** *ZyIndex, Version 5.0*, \$395; *Network Pack*, \$995 (includes three concurrent user licenses). ZyLab, a Division of Information Dimensions Inc., 100 Lexington Dr., Buffalo Grove, IL, 60089; 800-544-6339, 708-459-8000; fax, 708-459-8054.

Circle 413 on reader service card

IMPROVED

Lights! Camera! A New Version of Macromedia's Action!

Macromedia's multimedia presentation package, Action! 2.0 for Windows, now includes data-driven charting capabilities with automatic motion and DDE (Dynamic Data Exchange) links. The new feature lets users create full-motion 2-D and 3-D charts, such as pie and bar charts, and link them to Windows applications that support DDE, such as Microsoft Excel or Lotus 1-2-3 for Windows. When source spreadsheet data is changed, the moving Action! chart is automatically updated.

The update sports new MIDI sound support and improved capabilities for importing slide presentations. Users can now import images from applications such as Harvard Graphics, Persuasion, Lotus Freelance, or PowerPoint in a single step; automatically separate text and

BRIEFS

Clip-Art Collections

Image Club Graphics is shipping a new volume of clip art to its DigitArt library. Volume 24, Science and Medicine (\$99), contains 200 Encapsulated PostScript images including anatomy, health care and medical symbols, and earth, space, and physical science images. 403-262-8008; fax, 403-261-7013.

Masterclip Graphics is shipping two lines of hand-drawn color clip-art images. Volumes (\$149.95 each), six multitheme collections consisting of 200 to 400 images, are available in both .CGM and proprietary Harvard Graphics formats. Series (\$39.95 each), consists of 24 single-subject collections of 55 to 60 images in .CGM format. 800-292-2547, 305-983-7440; fax, 305-967-9452.

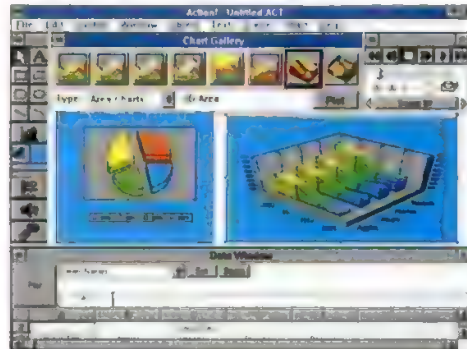
Windows Software

Firesign Computer's Outbound for Windows, Version 1.0, is a file-transfer program for exchanging data between IBM 370 and 390 mainframe systems and PCs running Windows 3.x. Once installed on workstations, the program runs constantly and provides a graphical display of the file-transfer process, statistics, and history. Pricing depends on mainframe processor group, with a typical installation running about \$15,000. Individual PC copies are available for \$150 each. 800-825-7228; fax, 415-398-5755.

Nordra Technologies is shipping TimeOut! Lite for Windows, Version 1.0 (\$269 for 15 users), which combines a telephone message system with a sign-out pegboard. Designed to help managers and receptionists keep tabs on the whereabouts of employees, TimeOut! Lite provides users with a window of the pegboard and offers a variety of sign-out messages such as "Out to Lunch" or "Gone for the Day." 201-786-6878; fax, 201-786-5868

RAN Enterprises' EyerCise 1.0 for Windows (\$69.95) is designed to reduce eyestrain and muscle fatigue by scheduling periodic rest breaks that

graphics; and apply a multimedia template. Action! 2.0 for Windows also includes Macromedia's new royalty-free application player, PlayAct, allowing any PC running Windows to play back an Action! presentation without Action! running on the system.



Action! lets you create full-motion charts.

• **List Price:** *Action! 2.0 for Windows*, \$495; upgrade from Action! 1.0 for Windows, \$79. Macromedia Inc., 600 Townsend, #310W, San Francisco, CA 94103; 415-442-0200; fax, 415-442-0190.

Circle 414 on reader service card

NEW

Dataproducts Covers All the Bases with New Laser Printers

Designed to compete directly with Hewlett-Packard's network-capable LaserJet IIIsi, the Dataproducts LZR 1555 accommodates paper sizes up to 11 by 17 inches and incorporates HPGL and PCL 5 page-description languages. Equipped with a 68020 controller, RISC-based ASICs (application specific integrated circuits) and 4MB of RAM standard (expandable to 16MB), the unit boasts output speeds of up to 15 pages per minute—three times as fast as the HP IIIsi, according to **Dataproducts Corp.** Targeted at the CAD/CAM market as a fast, low-cost plotter, the LZR 1555 also doubles as a PCL 5 networked laser offering resolutions up to 400 by 400 dots per inch.

Dataproducts has also unveiled the LZR 965, a 600- by 600-dpi, 9-page-per-minute RISC-based desktop laser printer featuring Adobe PostScript Level 2. The unit ships in standard configuration with 8MB of RAM (expandable to 16MB) and a SCSI interface for hard drive connection.

• **List Price:** *Dataproducts LZR 1555: single-tray model*, \$5,995; *two-tray model*, \$6,495; *three-tray model*, \$6,995. *Dataproducts LZR 965*, \$2,295. *Dataproducts Corp.*, 6219 De Soto Ave., P.O. Box 746, Woodland Hills, CA 91365; 800-334-3174, 818-887-8000; fax, 818-887-4789.

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WHAT, EXACTLY, IS ACCEPTABLE RISK?

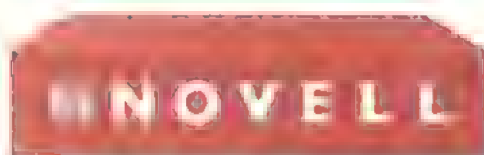
Last night you powered down a cholesterol-rich pasta with cream sauce. This morning you jaywalked across a busy four-lane street, and next weekend you're going to trust some nineteen-year-old who tells you there's no way the bungee cord can break.

Next to that, choosing new computer equipment is merely *career threatening*.

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IMPROVED

Raosoftware Ships Update to Its DOS-Based Report Writer

EZReport, Version 1.2, from **Raosoftware**, lets users generate custom reports from dBASE databases or the company's own statistical database, Survey, Version 2.0. The package employs an Intuitive Command Structure (ICS) consisting of a simplified command set of English words that enables users to create reports with no prior training or programming skills, according to the company.

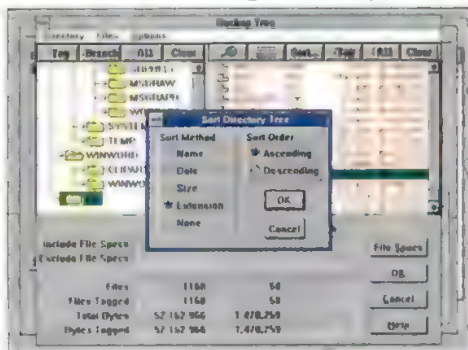
EZReport automatically sorts, prints headers, and paginates. It can link data from multiple databases, sort by group and case, group data by fields, and print subtotals. It also creates memory variables for temporary calculations, calculates formulas using field names values, and supports standard formulas such as sum, count, and average. Owners of Raosoftware's Survey and SurveyFirst can purchase EZReport, Version 1.2, for \$49.

• List Price: *EZReport, Version 1.2, \$149.* Raosoftware Inc., 6645 NE Windermere Rd., Seattle, WA 98115; 206-525-4025; fax, 206-525-4947. Circle 416 on reader service card

NEW

Backup Utility Provides Tape Support, Virus Detection

Gazelle Systems has unveiled its new hard disk backup utility for Windows 3.x, supporting more than 65 QIC, SCSI, and DAT tape drives. Back-It for Windows, Version 1.0, offers individual file tagging for backup and restoration, and file contents viewing. A memory-resident



Gazelle Systems' Back-It for Windows.

backup scheduler lets you run backups automatically in the background, and a pause/resume feature lets you stop backups in progress to access the DOS prompt. Preconfigured backup sets can be saved as presets and "iconized," letting users build icons represent-

BRIEFS

Windows Software

include stretches and eye exercises. The length and frequency of the exercises is user-defined, with the default settings providing 7 minutes of exercises every hour. 800-451-4487, 508-521-4487.

Software Grove is shipping *While You Were Out*, Version 1.0 (\$69.96), a Windows-based software package that lets you print out the familiar pink "While You Were Out" forms from a pop-up window on-screen. Users click on the icon, and the form appears. Actual messages are printed via any Windows-compatible printer. 800-793-0040, 206-823-0833; fax, 206-823-1246

WinWay is shipping *WinWay Resume* for Windows, Version 1.0 (\$69.95). The resume designer provides a selection of more than 35 resume styles, and a variety of fonts and bullets. On-line features include an action verb glossary, a 100,000 word spell-check dictionary, and resume samples. 916-332-2671; fax, 916-332-2529.

Apex Software is shipping *Cursoric! Pro* (\$69.95), a Windows 3.x utility that lets users resize, magnify, and change the shape of all Windows cursors. Users can select a number of supplied cursors, such as flashing arrows and animated golfers, or create custom designs and animate their original cursors. 800-728-7650; fax, 712-324-4578.

Uteley-Cross has unveiled the *Uteley-Cross SpellEnhancement* (\$89) for WordPerfect for Windows. The package speeds up spelling correction by generating a supplementary dictionary of ASCII word lists. A version of the software for WordPerfect for DOS is also available. 508-263-0386

Window Painters is shipping *SnapPRO!* (\$69.95), an image capture utility for Windows that combines screen capture, image editing, and graphics file conversion. *SnapPRO!* is available as an upgrade (\$10) to *SnapIT!* 612-897-1305; fax, 612-897-3648

ing individual presets. Future backups are initiated by double clicking on the icon.

Back-It for Windows also includes the Windows anti-virus utility *WinProtect*, providing virus detection and eradication of more than 1,300 viruses.

• List Price: *Back-It for Windows, Version 1.0, \$99.95.* Gazelle Systems Inc., 800-786-3278, 801-377-1288; fax, 801-373-6933.

Circle 418 on reader service card

NEW

Scan and Digitize Color Photos at 500 Dots per Inch

Using a proprietary CCD (charge-coupled device) sensor technology, **Polaroid's** CS500i Digital Photo Scanner for Windows scans 24-bit color images (up to 4 inches by 6 inches) at a maximum resolution of up to 500 dpi. The unit ships with the company's SprintScan image manipulation and processing software to enhance images.

Designed to let Windows users integrate artwork into applications such as desktop publishing or presentation graphics, the CS500i captures both 24-bit color and 8-bit gray-scale images at 125, 250, or 500 dpi. Scanned images are saved as TIFF or .BMP graphics files.

• List Price: *CS500i Digital Photo Scanner, \$4,495.* Polaroid Corp., 575 Technology Sq., Cambridge, MA 02139; 800-225-1618, 617-577-2000.

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IMPROVED

PC Paintbrush Gains a Magic Wand, Additional Filters

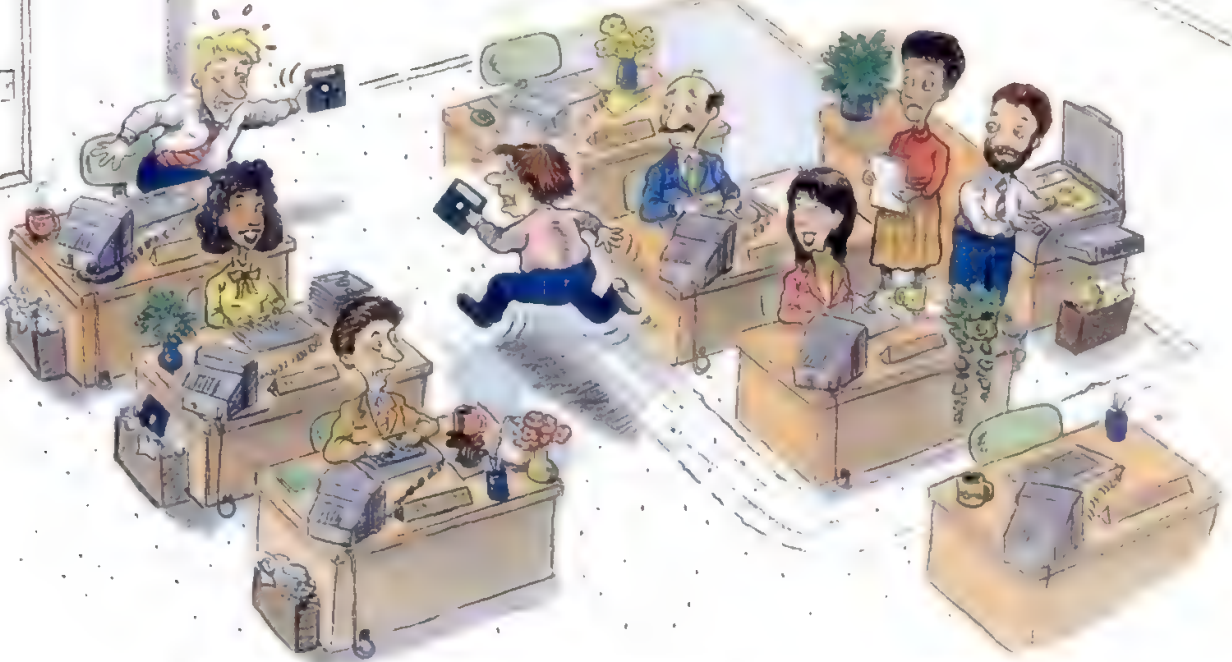
ZSoft Corp.'s latest update to its DOS-based color and gray-scale image-editing software package, *PC Paintbrush*, now provides users with a Magic Wand tool that automatically selects areas of similar colors. The new version, *PC Paintbrush 5+*, ships with a set of new filters, including preset gamma curves, color balance, emboss, and motion blur.

A new *Stitching* feature lets users reassemble an image scanned in several sections, and a *Perspective* feature can make portions of an image appear closer or further away than other portions, creating the illusion of depth. A number of brushes for gray-scale images and cloning capabilities are also new.

• List Price: *PC Paintbrush 5+, \$149; upgrade from previous versions, \$69.* ZSoft Corp., 450 Franklin Rd., #100, Marietta, GA 30067; 800-444-4780, 404-428-0008; fax, 404-427-1150.

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Let's Talk Modular Networking Starter Kits and Expansion Kits are also available through DATA SPEC dealers worldwide. Call 1-800-538-8255 for the location nearest you. DATA SPEC, 9410 Owensmouth Avenue, Chatsworth, CA 91311 • FAX: 818-718-8667

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IMPROVED

Peachtree Software Adjusts Its Product Line—Again

On the heels of its introduction of its new \$99 small-business accounting software for the DOS, Windows, and Mac platforms, **Peachtree Software** has updated its \$249 Peachtree Complete III and changed the name of the package to Peachtree Complete Accounting.

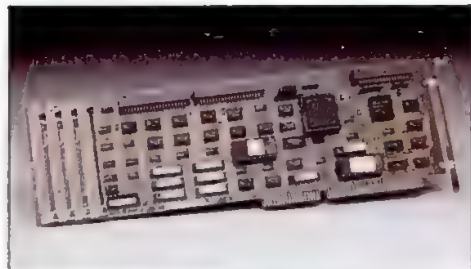
The new version, 6.0, includes Peachtree Data Query, a custom reporting package previously sold separately for \$199. Notable among the other 25 reported improvements are service invoicing, custom invoice designing, extended dunning messages, new accounts receivable query options, expanded customer lookups, and expanded vendor lookups. Current Peachtree users can upgrade for \$99.

• **List Price:** *Peachtree Complete Accounting, Version 6.0*, \$249. *Peachtree Software, 1505-C Pavilion Place, Norcross, GA 30093; 800-247-3224, 404-564-5700; fax, 404-564-6000.*
Circle 420 on reader service card

NEW

Alpha Debuts Plug-and-Play Caching Disk Controllers

Alpha Research's five caching disk controllers, including models designed for PCs with local-bus architecture, can access data between 280 and 1,400 times faster than a conventional hard disk, according to the company. The Series 400 line of controllers uses standard 256K, 1MB, and 4MB SIMMs, and supports two floppy disk drives as well as tape drives, disk mirroring, and data compression systems.



Alpha's S4251 Caching Disk Controller.

The ISA-based Series 400 S4251 supports up to four IDE drives and offers a maximum RAM cache of 16MB. The EISA-based Series 400 S450I supports up to four IDE drives and offers a maximum RAM cache of 24MB. Designed for the local-bus architecture, the Series 400 VL475I supports up to four IDE drives, and it offers a maximum RAM cache of 16MB. Two

BRIEFS

Graphics Boards

AvTech Development is shipping the GraphTEK 2 Windows accelerator board, available configured with 512K VRAM (\$199) and 1MB VRAM (\$275). The unit supports resolutions up to 1,024-by-768 at a refresh rate of up to 77 Hz. 800-886-5880, 714-773-5880; fax, 714-773-5881.

Diamond Computer Systems' SpeedStar 24X (\$249) is a DRAM-based graphics processor board that ships in standard configuration with 1MB DRAM and supports 2-, 8-, and 16-bit color. The unit supports a maximum resolution of 1,280-by-1,024. 408-736-2000; fax, 408-730-5750.

Evershine Technology's VEGA 5000 (\$179) offers HiColor RAMDAC support of up to 65,000 colors at a maximum resolution of 800-by-600 at a refresh rate of up to 76 Hz. It ships with 1MB VRAM. 408-734-3937; fax, 408-734-3417.

Hercules Computer Technology's Chrome is a megapixel true-color graphics accelerator board for ISA- and EISA-bus PCs. Available in three versions, the board ships in its standard configuration with 3MB VRAM and 1MB DRAM, and supports 24-bit color at a maximum resolution of 1,152-by-900. The Hercules C531 (\$1,695) has a 33-MHz graphics processor, and the Hercules C631 (\$1,895) has a 40-MHz graphics processor. The Hercules C731 (\$1,995) has a 40-MHz graphics processor and supports refresh rates of up to 90 Hz at 1,152-by-900 resolution. 800-532-0600, 510-540-6000, fax, 510-540-6621.

Number Nine Computer's #9GXITC (\$2,295) offers 32-bit or 24-bit color at a maximum resolution of 1,024-by-768, and 65,000 colors at resolutions of 1,152-by-900 and 1,280-by-1,024. The unit includes the company's upgraded HawkEye feature set, which provides users with such capabilities as screen magnification, resolution control, virtual screen control, and the ability to select cursor colors from a pop-up menu. 617-674-0009; fax, 617-674-2919.

additional controllers, the Series 400 S450S for EISA systems and the Series 400 VL475S for local-bus systems, support seven SCSI devices and offer a maximum RAM cache of 16MB.

• **List Price:** *Series 400 S4251*, \$350; *Series 400 S450I*, \$549; *Series 400 VL475I*, \$795; *Series 400 S450S*, \$725; *Series 400 VL475S*, \$795. *Alpha Research Corp., Park North Bldg., #120 8200 Mopac Expwy. North, Austin, TX 78759; 512-345-6465; fax, 512-345-6496.*

Circle 422 on reader service card

NEW

Don't Say DAT When You Talk About Tandberg

Tandberg Data's Panther 2000 tape backup system is the first to provide 2 gigabytes of QIC-standard storage from \$3,100 (or up to 4GB with data compression). Tandberg's system is backward-compatible with other QIC recording formats, is less expensive, has a longer mean time between failures, is less sensitive to temperature and humidity, uses higher quality tape, and is 67 percent faster than DAT backup systems, according to the company. The Panther 2000 is available in internal and external models.

• **List Price:** *Panther 2000*, \$3,100 (\$5,600 external). *Tandberg Data Inc., 2649 Townsgate Rd., #600, Westlake Village, CA 91361; 805-495-8384; fax, 805-495-4186.*

Circle 421 on reader service card

NEW

Patton Unveils Short-Range Modem with V.54 Test Modes

Patton Electronics Co. is now shipping the Model 1080 "Universal" Short-Range Modem, providing data transfer in both synchronous and asynchronous RS-232 environments. The modem, designed to provide both point-to-point and multipoint communications over short ranges (such as industrial parks, college campuses, and military installations), supports distances of up to 13 miles and data-transfer rates from 1.2 to 19.2 kilobytes per second, according to the company.

The unit provides two built-in V.54 test modes to assess system integrity: local analog loopback and remote digital loopback. The tests can be initiated from a front-panel switch, or via an RS-232 interface.

• **List Price:** *The Patton Model 1080 "Universal" Short-Range Modem*, \$295. *Patton Electronics Co., 7958 Cessna Ave., Gaithersburg, MD 20879; 301-975-1000; fax, 301-869-9293.*

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cc:Mail offers an impressive set of administration tools. Such as Automatic Directory Exchange, a product which automatically collects any changes



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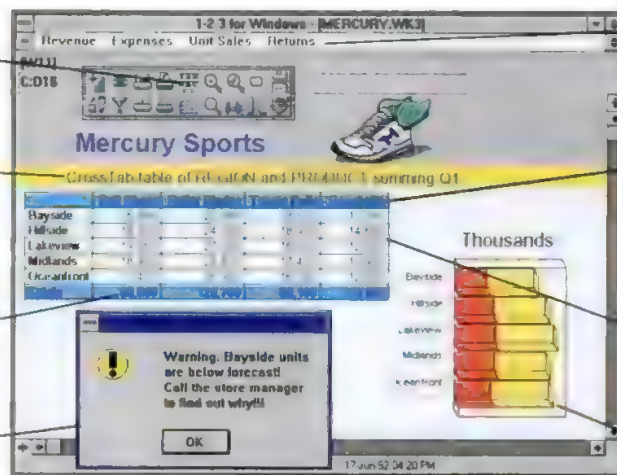
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Lotus 1-2-3 for Windows

*Based on Software Publishers Association data, Q1 1992, for North America. **This disk is free for current users of 1-2-3 for Windows Release 1.1. New buyers of 1-2-3 for Windows Release 1.1 will find SmartPak in their product package at time of purchase. Network version of 1-2-3 for Windows Release 1.1 is available. Please note that the SmartPak Disk works only with 1-2-3 for Windows Release 1.1. ***Please have credit card and product package ready when you call. In Canada, call 1-800-40-LOTUS. © 1992 Lotus Development Corporation. All rights reserved. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. Classic is a registered trademark licensed to Lotus Development Corporation. SmartPak is a trademark of Lotus Development Corporation. Microsoft is a registered trademark and Windows is a trademark of Microsoft Corporation.

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

So, You Want to Be a Windows Expert. . .

The best way to master Windows 3.1 is to experiment with the software, then pester colleagues for advice. Whether you're the one giving the advice or receiving it, these six books, which vary in scope and level, will help you cut through the confusion.

Learning & Running Windows 3.1

At first glance, *Learning & Running Windows 3.1* looks much like a dozen other guides to Windows. Look again. This book and disk combine Craig Stinson's uniquely lucid and well-organized book, *Running Windows 3.1*, with the Microsoft Productivity Pack for Windows, a surprisingly detailed on-line tutorial and troubleshooting software package. If you want to use Windows effectively and don't need all the advanced details found in books like *Windows 3.1 Secrets*, you won't find a better guide. Even if you need technical details, you may find them among Stinson's well-chosen tips.

The book (available separately for \$27.95) stands out for the efficiency of its prose and the accuracy of its information. It covers every aspect of Windows' built-in utilities without wasting words. More experienced users can skim the main text and focus on the tips.

Most guides to Windows focus on options. Stinson,

more than anyone else, also tells you about the problems you can expect when an option fails. His warnings can make any Windows session more productive for you and more safe for your data.

The Microsoft Productivity Pack is unique among disks bound into non-specialist computer books. It contains useful software that (unlike the software bound into rival Windows volumes) can't be downloaded from a BBS for a few cents' worth of connect time. Expert users won't need this software, but if you are not an expert yet, it helps you become one.—Edward Mendelson

• *Learning & Running Windows 3.1*, by Craig Stinson, \$39.95, Microsoft Press, One Microsoft Way, Redmond, WA 98052-6399; 800-677-7377, 206-882-8080. ISBN: 1-55615-431-3.

Circle 524 on reader service card

Maximizing Windows 3.1

Jim Boyce's *Maximizing Windows 3.1* is among the best choices for serious users who need in-depth material. New Windows users will find the book rough going, but veterans will love the scope and level of this 900-page guide.

His coverage of the new Windows 3.1 features includes a 40-page chapter on

OLE (object linking and embedding) that goes way beyond the basics. He describes how to use the Object Packager and how to manipulate the registration database with Regedit.

Extensive coverage is given to Program Manager and File Manager as well as third-party utilities. The section on Windows shells has minireviews of Whiskers, hDC Power Launcher, hDC Windows Express, Sidebar, and The Norton Desktop for Windows.

Several chapters offer strategies for optimizing and customizing Windows, with details on memory management, SYSTEM.INI parameters, and swap file settings. There are also directions for turning .PCX files into wallpaper and an explanation of the CONTROL.INI file used by Control Panel.

If you want to get your feet wet in developing Windows programs, there are two chapters that focus on batch languages and Visual Basic, with some discussion of the Windows SDK (Software Development Kit), C++, and Turbo Pascal for Windows.

The book comes with two disks filled with 6MB of shareware and freeware goodies, including an icon editor, a communications program, a checkbook, a Post-it program, and Windows shells.

If you use Windows regularly and need to take control of your environment, you'll want *Maximizing Windows 3.1* at your side.—Barry Simon

• *Maximizing Windows 3.1*, by Jim Boyce, \$39.95, New Riders

Publishing, 11711 N. College Ave., Carmel, IN 46032; 800-428-5331, 317-573-2500. ISBN: 1-56205-044-3.

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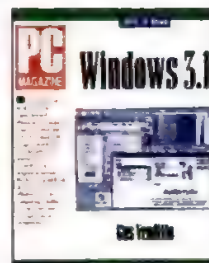
PC Magazine Guide to Windows 3.1

He promises to help save you time, not bog you down. Gus Venditto, editor of *PC Sources* and columnist and former executive editor for *PC Magazine*, has written a how-to book "for people who want to get more from their computer so they can get home earlier." *PC Magazine Guide to Windows 3.1* tours the highlights of Windows 3.1 in clear and succinct writing, with extensive coverage of the components new to Windows 3.1.

Venditto starts with a tutorial on Windows conventions, and follows with detailed discussions of Program Manager, File Manager, and Windows 3.1

applets, including the new Sound Recorder and Media Player. In the chapter on printing, you'll find a great deal of information on fonts and a lucid explanation of the difference between raster and vector fonts, with special attention paid to TrueType.

The *Guide* ventures beyond where most elementary Windows books end by considering SysEdit, OLE, the Object Packager, and multiple setup configurations. There is some advice on optimization, but advanced users will not find the more complete advice they need for tuning Windows itself. A glossary states the main parameters in SYSTEM.INI, but there's little information on when you



Windows

might want to change them. And the discussion of time-slice parameters is mostly definitional.

The book is thoughtfully designed and filled with conveniences. There's a section on DOS basics, and each chapter

ends with a menu structure for the applets discussed so you can easily coach friends over the phone. The *PC Magazine Guide to Windows 3.1* is an excellent choice for a clean, clear introduction to the ins and outs of Windows.—Barry Simon

• *PC Magazine Guide to Windows 3.1*, by Gus Venditto, \$27.95, Ziff-Davis Press, 5903 Christie Ave., Emeryville, CA 94608; 800-688-0448, 510-601-2000. ISBN: 1-56276-009-2.

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SuperCharging Windows

Judd Robbins's *SuperCharging Windows* is aimed at sophisticated users and provides more technical detail than most competitors. If you really want to know what goes on behind the screen, this is the book for you.

For example, consider his discussion of memory. Most elementary books try to describe what expanded and extended memory are in very general terms, but Robbins gets into memory addressing. He goes even further and discusses the local descriptor tables and selectors used in protected mode.

Covering all the bases, he examines such topics as Windows memory management, DDE (dynamic data exchange), OLE, multimedia, optimizing PIFs, WIN.INI and SYSTEM.INI parameters, fonts, and networks. The chapter on troubleshooting is in Q&A format and addresses some of the most common questions—there are close to 50. For example, "Does it matter whether I

locate SMARTDRV.EXE and HIMEM.SYS in the root or in another directory in the PATH?" And, "When I try to print, the printer just spits out page after page of garbage characters. What's up?"

The book's flaws are its often wooden prose and insufficient number of screen shots.

More serious, however, are the errors. Robbins claims Windows can't run in Standard Mode if DOS 5.0's EMM386 .EXE is loaded. This is true for Windows 3.0, but not for Windows 3.1. He also says that the Startup Group in Program Manager replaces the Run line in WIN.INI (which loads programs normal size) but not the Load line (which loads programs minimized). In fact, Program Items have a "Load Minimized" checkbox, so the Startup Group can replace both lines.

As with many of the other books, *SuperCharging Windows* includes two floppy disks of shareware and freeware, including WinPost and Whiskers. Despite its flaws, if you need to take a close look at Windows at this level of technical depth, *SuperCharging Windows* is a good choice.—Barry Simon

• *SuperCharging Windows*, by Judd Robbins, \$49.95, Sybex, 2021 Challenger Dr., Alameda, CA 94501; 800-227-2346, 510-523-8233. ISBN: 0-89588-862-9. Circle 527 on reader service card

Tricks of the Windows 3.1 Masters

If you judge by this book, the Windows 3.1 masters know almost a thousand pages of tricks, many valuable and little-known, some incomplete or misleading, and some just plain wrong. W. Edward Tiley's

Tricks of the Windows 3.1 Masters is designed for users experienced with Windows who want to extend their knowledge by customizing and streamlining their systems.

The early chapters offer shrewd tips on installation, fonts, printers, and other basics. The middle—and most useful—chapters offer overviews of Windows programming, so you can know what to expect from different programming tools—Borland's Resource Workshop, Norton Batch Builder, Visual Basic, Windows SDK—before you buy. There's also a chapter on building apps with the limited version of Realizer that's included with the book. The last section guides you through the accompanying three disks of shareware. (Note, however, that you can download the same programs from CompuServe or a BBS for just a few pennies.)

Some of the book's omissions and errors result from the author's use of out-of-date software, including the beta version of Windows 3.1. Fortunately, the mistakes seem harmless, such as a needless warning not to put spaces between the names of applications in WIN.INI's Load and Run lines. Other mistakes, such as the statement that the HP LaserJet III includes Bitstream's Dutch and Swiss fonts instead of fonts with different names from Agfa Compu-graphic, are more bothersome.

There's plenty of gold in these thousand pages, but you'll have to pan it carefully to distinguish it from the fool's gold.—Edward Mendelson

• *Tricks of the Windows 3.1 Masters*, by W. Edward Tiley, \$44.95, Sams, 11711 N. College Ave., Carmel, IN 46032; 800-428-5331, 317-573-2500. ISBN: 0-672-30135-0.

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Windows 3.1 Secrets

If you were serious about running Windows 3.0, you probably bought Brian Livingston's book of Windows tips and techniques, now updated as *Windows 3.1 Secrets*. The new edition presents even more troubleshooting advice and an even wider range of advice on customization and streamlining than the earlier one.

Like most authors, Livingston—*InfoWorld's* Windows columnist—offers keyboard and mouse shortcuts for Win-

dows applications and Windows' own desktop utilities. Where he differs from most authors, however, is in the vast quantity of advice he delivers on getting Windows to work with specific

hardware. If you're having trouble getting Windows to run, look for the answer in *Secrets* before you look anywhere else.

Livingston gives the most extensive guidance on making DOS applications work effectively under Windows and the most detailed advice on clearing up problems caused when installing older utilities in Windows 3.1.

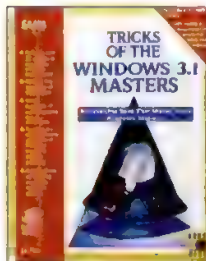
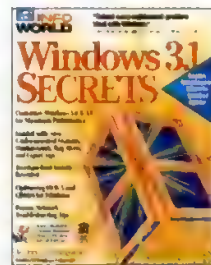
Good as it is, *Windows 3.1 Secrets* can't substitute entirely for the guidance you'll find in publications like Microsoft's *Windows Resource Kit*. Livingston evidently worked largely from the beta version of Windows 3.1, and so he omits some useful WIN.INI settings.

You'll also get three disks of shareware when you buy the book, but Livingston's enormous expertise makes the book well worth the price even if you choose to ignore the disks. □

—Edward Mendelson

• *Windows 3.1 Secrets*, by Brian Livingston, \$39.95, IDG Books, 155 Bovet Rd., San Mateo, CA 94402; 800-282-6657, 415-312-0650. ISBN: 1-878058-43-6.

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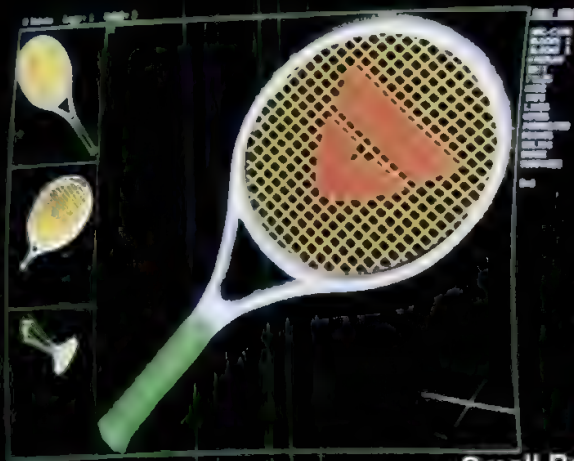
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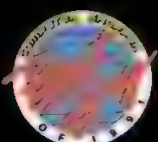
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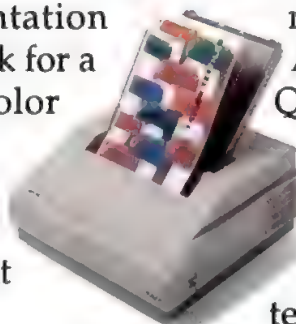


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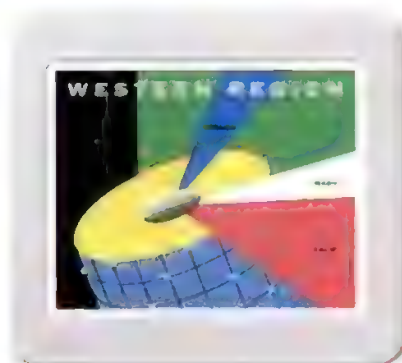
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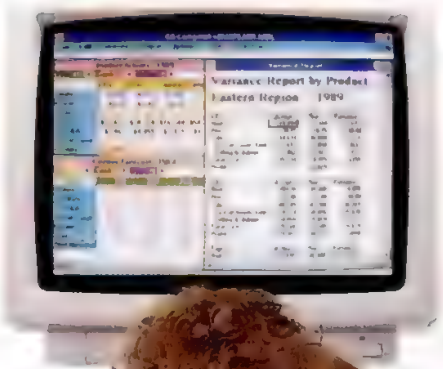
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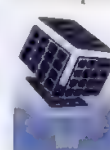
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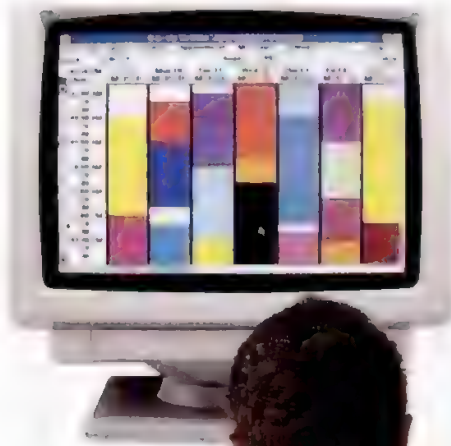
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Michael J. Miller

Backstage with CD-ROM

COLUMNIST PHOTOGRAPHS BY PETER GREGOIRE

If multimedia is going to take off in the business world, the compact disk will play a starring role. CD-ROM seems to have everything going for it, so what's slowing its arrival in the business mainstream? First, the good news.

Packaging. Now that some standards are emerging for both CD-ROMs and audio disks, multimedia is becoming more than a buzzword. The next application you buy may come on a silver platter loaded with a smorgasbord of text, graphics, sound, and animation files. There's no need for developers to market the programs in bulky packaging with weighty manuals. You can find most of the documentation on-line, though you'll still need a short manual to walk you through installation.

Distribution. CD-ROM is now the preferred way to distribute huge databases, from Computer Library's Computer Select and Support on Site to Lotus One Source and Compton's Multimedia Encyclopedia. With a capacity of 600MB, the CD-ROM allows developers to give you much more than just program files.

Installation. With more applications requiring a dozen or so floppy disks, installation is a pain, even when installation programs work well. You'll find it much simpler to install a program from a single disk.

Information. CD-ROMs also let you access much more information than you can with a hard disk. You would never want to fill up your hard disk with all the clip art in CorelDRAW. But the ability to search a CD-ROM for the image you want makes perfect sense.

MULTIMEDIA MOVIES

You'd be impressed with some of the latest CD-based applications. Combining sound and animation to produce "movies," some programs let

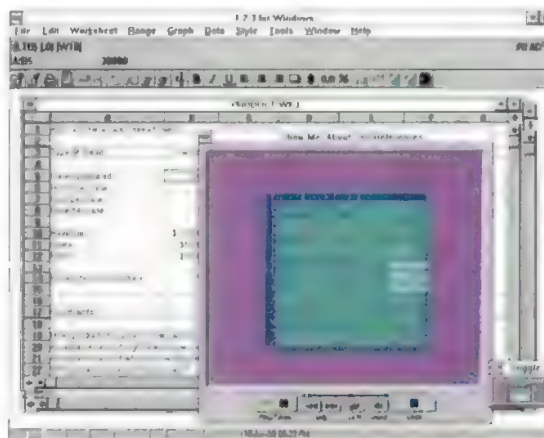
you sit back as they take you on elaborate tutorials. One of the early adventurers was Microsoft Works for Windows, Multimedia Edition, which includes multimedia tutorials and a graphical help system.

Lotus has moved in the same direction with Multimedia SmartHelp for 1-2-3 for Windows. This CD-ROM includes 1-2-3 for Windows and an extensive help system that explains the program's multimedia components. Even more impressive is its lineup of short movies that fall into two categories: conceptual and procedural. Lotus did an excellent job of creating tutorials that use animation and sound to show you how the program works and how to perform specific tasks. The multimedia help system can really assist you in learning the program and running it smoothly, without referring to printed documentation. It's the best example of a multimedia tutorial I've yet seen.

Microsoft has taken a different approach by loading CD-ROMs with more information rather than better tutorials. Microsoft Word for Windows and Bookshelf, Multimedia Edition, adds Multimedia

Bookshelf 1992 to the toolbar in Word. Though its multimedia features aren't as extensive as you may expect, Bookshelf has an almanac, an encyclopedia with some clever animations, and a couple of dozen spoken quotations from Bartlett's *Familiar Quotations*, with portraits of the authors.

Finally, there's some integration between the two programs, so you can copy information from Bookshelf into Word or set Word to start each day's session with a



Confused about CD-ROM? The next application you buy may show you everything you need to know.

Michael J. Miller

"quote of the day." With this software combo, Microsoft gives users a range of information, but it doesn't go the full route of running tutorial movies.

The CD-ROM as information carrier is taken to its fullest with CorelDRAW 3.0. Most programs offer CD-ROMs as separate packages, but CorelDRAW includes both floppy disks and a CD-ROM in every package. You can install the basic program from either medium, but the CD-ROM contains hundreds of fonts and thousands more clip-art images that don't come on the floppy disks.

THE RIGHT (AND WRONG) TRACK

With all its advantages, why is the CD-ROM drive still backstage? Because the drives and audio systems—the components that would make multimedia take off in the business world—are still too complicated for most users to install. The software developers, too, will have to

work out the details of usability.

When you start to think about how CDs work, you'll quickly discover that everything old is new again. Remember back when PCs had only a single floppy disk? You had to make sure you had the right disk in the drive, and it seemed like you spent half your time swapping disks. You'll get the same feeling working with a CD-ROM.

You wouldn't want to actually execute programs from CD-ROM drives since they're much slower than hard disks. All the business applications I've seen that come on CD-ROM install the program files on your hard disk. You certainly don't want to wait for the CD-ROM drive to kick in every time you choose another feature of the program.

Applications also have to be smart enough to tell you whether you've installed the proper disk. It's a minor problem, but one developers need to tackle. With the prerelease of the newest version of Microsoft Word, if you don't have the proper CD-ROM installed, you'll get a strange error message. Smarter applica-

tions such as Lotus 1-2-3 don't need the disk for basic help. When it does need the disk to run a movie, it simply asks you to insert the CD-ROM.

Another problem is that data on CD-ROMs is permanent, which makes them more difficult for developers to update than programs on floppy disks. And since there are still only a limited number of CD-ROM drives currently in use, developers are going to concentrate on updating the floppy disk versions. For instance, the new version of the SmartPack additions to 1-2-3 for Windows comes only on a floppy disk. However, you can still get the new features by installing the floppy version of SmartPack over the CD version of 1-2-3.

Fortunately, developers are getting the message. With new machines such as Compaq's Deskpro/i models adding sound as a standard feature, with CD-ROM and sound systems improving, and with graphics, sound, and animation making their way into the mainstream, multimedia may finally make sense in the business world. □

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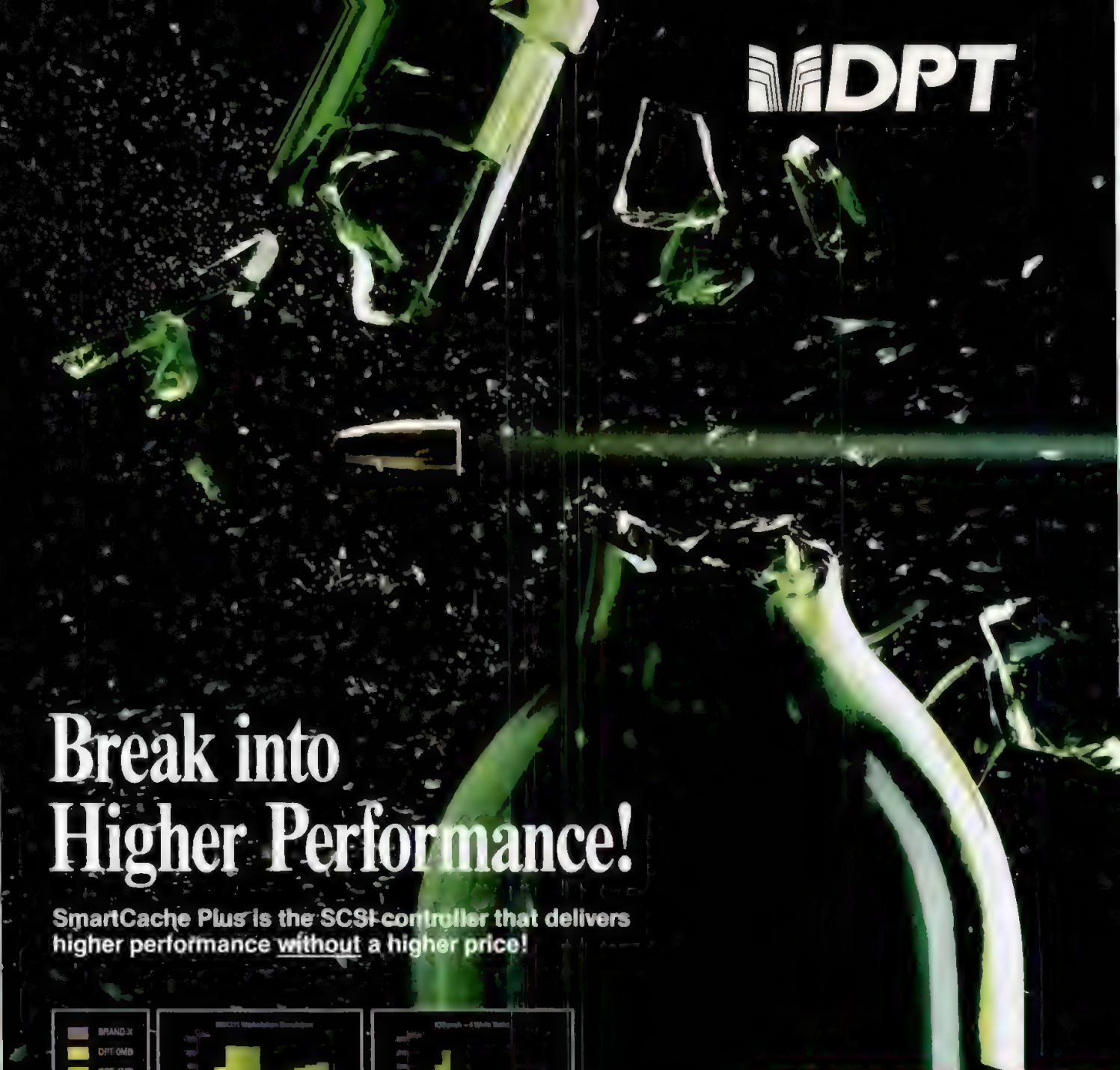
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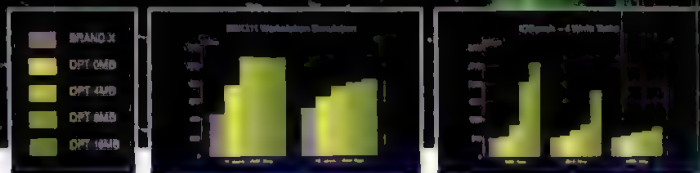
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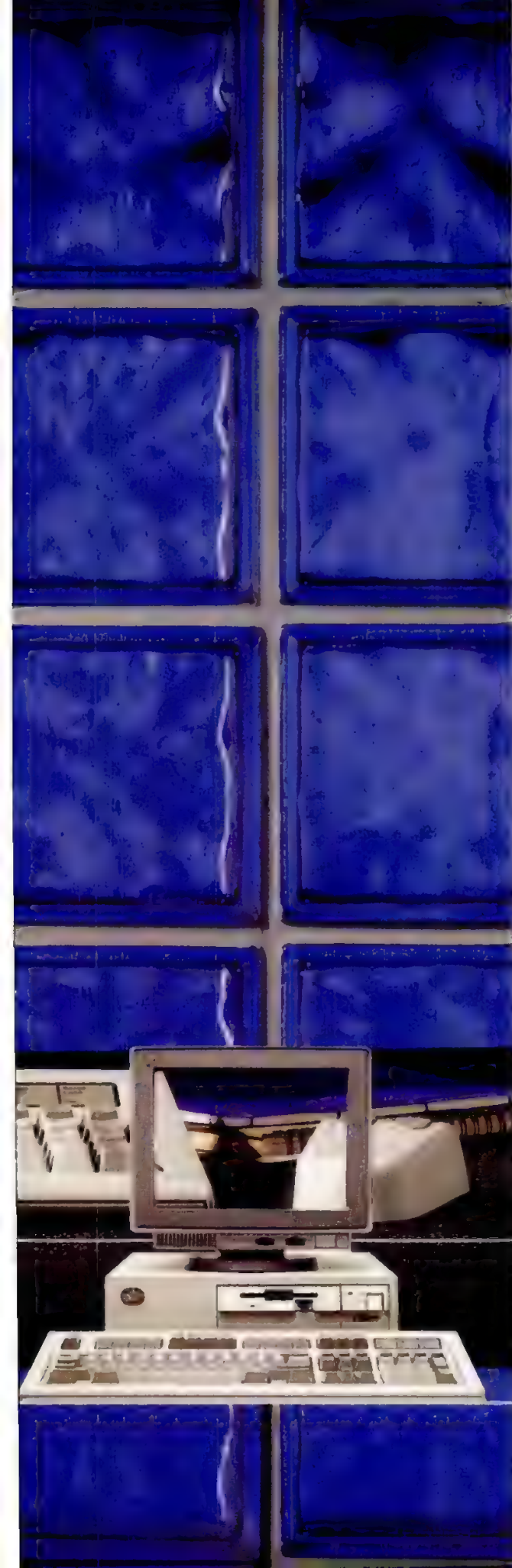
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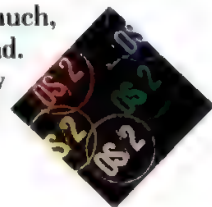
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Bill Machrone

World-Beating Strategies

Back in the mid-eighties, we used to joke about IBM's master plan. "TWD," we called it. Total World Domination. Back then, it was easy to see how IBM's product strategies interlocked to create an indomitable game plan. When a

PC Magazine staffer asked why IBM chose some course of action, the answer was always "TWD."

Today, IBM doesn't seem to have a master plan, other than to gain back some of its shattered market share. Interestingly enough, no computer manufacturer is in a position to have a world-dominating master plan. The nineties belong to the chip manufacturers and the software companies.

Microsoft, of course, is in the strongest position of all. You can insert your own statements about having the world's most widely used operating system. Add the inevitability of Windows 3.1. Then you can add NT, the languages, and what is becoming a superb suite of applications. Bill Gates's original dream of a microcomputer on every desk and in every home (running Microsoft software, naturally) is well on its way to becoming reality. Nothing can stem the tide, and other companies can only hope to find their businesses in the interstices. Fortunately for them, as Microsoft grows larger, the businesses that are too small for Microsoft to notice will grow larger, too. I'm continually reminded of an old proverb: "When the lion feeds, no one in the jungle goes hungry." Picking over the bones of Microsoft's kill may not be an appetizing picture for other software companies to paint for their stockholders and customers, but there's money in it.

CROSS-POLLINATION

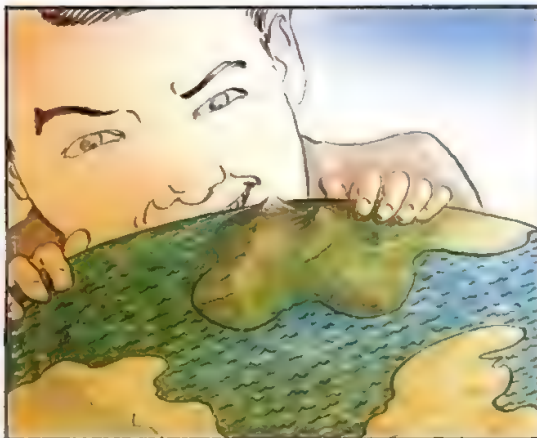
Microsoft owes much of the strength of its applications to its cross-platform strategy. Word and Excel benefit enor-

mously from the seesaw of implementations on the PC and the Macintosh. Microsoft Mail will be a good package one of these days. And the Fox acquisition finally gives Microsoft a world-class database product. The outside world may never know the full story of Microsoft's attempts and failures in the database arena, but it won't matter in the long run. Having a full suite of applications has suddenly become very important for the corporate sale.

Lotus, like Microsoft, has a full suite of applications. Its crown jewel is Lotus 1-2-3, and Ami Pro is a top-flight word processor, but the future is Notes. Lotus doesn't have an operating-system business to ride into the suites of corporate America, so it has to work harder to keep its place among key developers. Fortunately, Notes is unique and it addresses problems shared by many businesses. Users love the text database capabilities, the easy application development, the workgroup computing features, and the rich text formatting of everyday materials. Unfortunately, Notes has its flaws, chief among them poor support of on-the-road e-mail and a clunky approach to distributed databases. Still, Notes is a powerful integration tool and will keep Lotus in the highest circles of corporate systems development.

FRIEND AND FOE

Novell, through Ray Noorda's much-ballyhooed "coopetition," has its fingers in every pie. There's virtually nothing that Novell can't connect your PC to, from mainframes and mini-computers to worksta-



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CIRCLE 008 ON READER SERVICE CARD

Bill Machrone

tions and Macintoshes. If promiscuity ever had a place, this is it.

Novell's acquisition of Digital Research puts it squarely in contention with Microsoft for the hearts and minds of desktop users. DR DOS has been a great stimulus to Microsoft. We wouldn't have MS-DOS 5 without it. But fears of incompatibility, especially with Windows, have kept DR DOS at bay. And of course, MS-DOS comes with your machine. So why pay extra for another OS that gives only a marginal improvement?

Meanwhile, back at Microsoft, there's NT. The goal is to make it the be-and-end-all OS. Microsoft's on the right track. NT's symmetrical multiprocessing capabilities should be striking mortal fear into the heart of every minicomputer maker, because every PC maker with the wit to put a handful of 486 or 586 chips in one box will have a widely supported, turnkey OS and loads of performance.

NT will run on a variety of microprocessors besides Intel's, including DEC's Alpha chip and the MIPS R4000. These RISC chips are attempts to wrest back some market share from Intel and to have a modicum of independence from the silicon giant. Forget it, guys. This is Intel's decade. After all, why buy an expensive, proprietary machine from DEC or MIPS when the generic version runs the same software just as well? So while Microsoft is offering the old-line minicomputer companies a path to the future, the path leads to the killing fields.

Intel is indomitable in the microprocessor field. No other manufacturer has articulated an upgrade strategy as well ("Intel's Future: An Empty Socket," *PC Magazine*, January 14, 1992). The cloners, AMD and Cyrix, have strengthened Intel and contributed to the demise of ACE, the consortium that was supposed to redefine desktop computing. ACE was dysfunctional from the start, with each member having its own agenda. Compaq wanted a piece of Sun's market; MIPS wanted some of Intel's market; Silicon Graphics wanted to universalize 3-D graphics. And a couple of dozen PC vendors were afraid not to join, just in case it was the Next Big Thing. □

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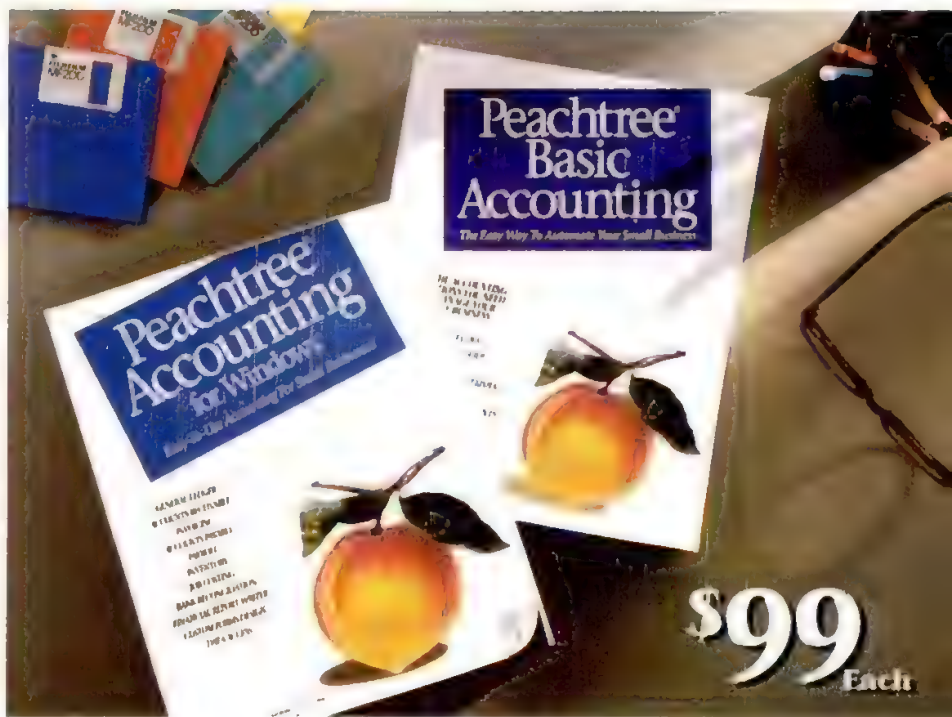
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THE INTELLIGENCE OF THE 386SL CHIP.

Intel designed the new 386SL processor specifically for notebooks. And they were right on target! According to *PC Magazine*, this sharp new processor "promises to extend the battery life of portable PCs significantly, not by drawing less power but by being intelligent enough to power-down the memory, disks, modem, video and ports when they are not in use. The results can be impressive..."

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John C. Dvorak

Kiss Your ASCII Goodbye

Business and communications are going international, but the PC hesitates to cross the language barrier. Though you really don't want to type in any character set except your native language, what if you want output in Icelandic or Arabic? For

intercultural communications, ASCII just doesn't cut it. The solution is Unicode, and it's long overdue.

It was my experimenting with translation software that brought the problem to my attention. I write for the French and German counterparts of *PC Magazine* and decided to send them translated documents. Because of character set differences, I couldn't send the documents electronically. Even printing and faxing were problems. Too many characters were seen as control codes instead of Latin-1 characters (an ASCII superset that includes various symbols plus European letters). Sure, you can struggle with binary files and graphics instead of character sets. But what a hassle!

An easier and more universal solution is the Unicode standard. Within the next year or two you can expect worldwide adoption of this 16-bit character standard to replace 7- and 8-bit ASCII. While ASCII has 128 characters and Latin-1 has 256 characters, Unicode will open the door to 65,536.

It took an international battle to get Unicode accepted. Back in the heyday of Xerox PARC in the early 1980s, Xerox was promoting an international character set, but some members of the computing community decided they could do better. So an ISO (International Standards Organization) committee was formed to develop a 32-bit character set of all known characters and symbols. The committee, ISO 10646, instantly got bogged down in politics.

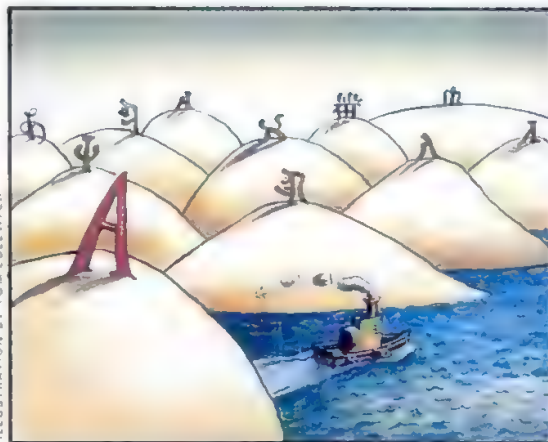
Meanwhile, a group of multilingual system implementers at Xerox,

including Joe Becker, Lee Collins (now at Taligent), and Eric Mader and Dave Opstad (both now at Apple), were already thinking about Unicode. (Becker coined the term.) They began with an ambitious project to unify the commonalities of Asian character sets, ultimately persuading the Chinese, Japanese, and Koreans to take joint ownership of this effort. Inspired by Mark Davis (from Apple's international division, and now at Taligent), they broadened participation to leading industry representatives, including Bill English (Sun Microsystems), Asmus Freytag (Microsoft), Mike Kernigan (Metaphor Computer Systems), Rick McGowan (NeXT), Isai Scheinberg (IBM), Karen Smith-Yoshimura (Research Libraries Group), Ken Whistler (a UC Berkeley linguist now at Metaphor), and many others.

Finally, a breakthrough compromise allowed Unicode to be a subset of ISO 10646, and ASCII and Latin-1 to be subsets of Unicode. ISO 10646 was passed by the member countries in June.

I don't know how ISO 10646 will ever fill up its over 4 trillion character slots, but until it does, Unicode will supply all the characters needed for the languages of the modern world—28,706 characters so far.

Unicode is published as *The Unicode Standard, Worldwide Character Encoding* (ISBN: 0-201-56788-1), \$32.95 from Addison-Wesley, 800-447-2226. Unicode Inc. provides tapes and seminars. You can contact Unicode at 1965 Charleston Rd., Mountain View, CA 94043; 415-961-4189.



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Inside Track

A new **frenzy** over small hard disks is beginning (yet again). This time it's mostly over the **1.8-inch disk**, which is expected to be the disk *du jour* in future 3-pound notebook machines.

The most interesting variation is the **sub-miniature 1.3-inch disk** from Hewlett-Packard. The untold story behind this smallest of hard disks is that HP solicited every drive maker to design something that would fit into an HP LaserJet cartridge, and **nobody** wanted to partake in this potential bonanza. Of course, HP wasn't going to pay anyone for development. So, about two years ago, the company started to develop its own small hard disk.

While the original concept was for a super plug-in cartridge, the disk will gravitate to HP's palmtop as a **hard disk within a PCMCIA card**. Observers believe that while the 1.3-inch hard disk may achieve up to 40MB in the next iteration, the 1.8-inch disk will quickly achieve 80MB. If drive makers can further flatten the 1.8-inch disk, it too can be part of a PCMCIA card, thus ruining the opportunities for the 1.3-inch disk. While this may be a **set-back to HP**, it still indicates that HP is back on the cutting edge of development. As of late, it's better known as a company that simply buys Japanese technology and glues the HP logo on it.

While on the Subject of Hard Disks Dept.: Hard disks have become so cheap that **smart software companies** see them as a new distribution channel. Microsoft has made a deal with Conner Peripherals to **pack a bunch** of Microsoft software on a hard disk for not much more than the price of a blank hard disk. Microsoft has done a marvelous job of finding new ways to **grab** market share. Giving away software for next to nothing is a good technique. Paying people to take software comes next.

Not really. This marketing scheme is nothing more than a **ploy** to create an irresistible software bundle. Microsoft plans to release a hard disk loaded with every conceivable software package it sells. Why Microsoft doesn't do this on a CD-ROM **baffles** me. Microsoft was the earliest promoter of CD-ROM, after all. Seems to me Microsoft's deal is an indictment of the CD-ROM.

*According to insiders,
Microsoft is freaked
by OS/2 and is dropping
every bomb it can find.
It plans to release a
hard disk loaded with
every software package
it sells, including
Windows, of course.*

Whatever the case, expect others to follow suit. **Borland** will have language and spreadsheet bundles. **Lotus** will have a bundle of some sort, depending on what mood they're in. **Novell** will bring out NetWare on a hard disk running under DR DOS. Can you imagine all the slots in your machine **clogged** with these disks? Sheesh.

Microsoft has **wisely avoided** the hardware business since it brought out a CP/M plug-in card for the Apple II in the late 1970s. The only reason it got back into the hardware business with its Microsoft mouse was to sell more mouse-dependent software.

(Can you spell W-i-n-d-o-w-s?) This hard disk plan is **out of character for the company**. According to insiders, **Microsoft is freaked** by OS/2 and is dropping every load of bombs it can find. Needless to say, **Windows will be bundled** on all these hard disks. Microsoft is hiding the rationale by taking on a partner and making the whole thing look like the partner's project. Microsoft does nothing this grandiose unless it's the lead partner.

Cheaper Chips Dept.: A few columns ago, I wrote about how Intel was attacking AMD in the chip wars and how the 486SX would become a leading chip of choice because Intel was bringing the price to \$100. Just as that piece ran, I was told that Intel is down to \$75 or \$80 for the chip, making it competitive with the inexpensive and superfast AMD 386 family. Of course we can expect this entire scenario to be repeated with the 586.

While on the Subject of Intel Dept.: The industry's best-kept secret is that Intel has a **motherboard plant in Puerto Rico**. I'm told that the company has quietly done a deal to make motherboards for the aggressive **Packard Bell** computer company. If it's true, I'm sure that will go over big with the Intel chip customers.

While on the Subject of AMD Dept.: AMD hasn't gone into systems yet, but it has jumped into networking with the first **one-chip Ethernet solution**. For next to nothing, the chip will allow desktop computer makers to add an Ethernet connection right on the motherboard. It'll first show up on add-in cards that may sell for **as little as \$50!** Hmmm, the desktop PC is sure sounding like a workstation, isn't it? Well, except for the price, that is. □



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Jim Seymour

The DOS-Windows Straddle

Straddles are among the most difficult maneuvers to sustain. Just ask a securities trader. Or a trick-riding cowboy. Or even a PC user. The straddle a lot of us are trying to pull off right now is riding both DOS and Windows. I find very few all-

Windows users among the businesspeople I work with. There are plenty of DOS-only PC users, but many say they're sorely tempted by Windows 3.1. Microsoft didn't get everything right—far from it—but 3.1's a lot better than 3.0, a good tool by any standard. And if DOS is the alternative, we're not exactly going up against perfection here.

Actually, the tug-of-war we feel has relatively little to do with the operating system, or operating environment. No one buys a PC to use its operating system; we buy PCs to use applications, to do real work.

So the real tug is between DOS apps and Windows apps.

Sometimes this is cast as an old-habits-versus-new decision. That's bushwa. If a new program does something important in our work lives, and does it a lot better than what we're using now, most PC users will switch.

Thus Excel's and Quattro Pro's success at stealing away some of the highest-profile 1-2-3 gurus.

Claiming people are too intimidated to change software because of their old habits is like saying executives don't type because they're afraid they won't look . . . well, executive. Both are antiquated notions.

So does that mean you should switch right away to Windows? It sometimes seems that way: Almost all the flashy new programs are for Windows, and once you've seen something like Word for Windows strut its stuff, it's hard to look drab old XyWrite or even WordPerfect 5.1 in the face again.

But as I've written often, jumping overnight to Windows—and its apps—can be a big mistake.

Let me tell you about something I've been doing that frustrates the Full Speed Ahead for Windows types. Not only do I use a mix of DOS and Windows apps on my PCs, I sometimes use a mix of DOS and Windows apps *for the same function*.

Two quick examples will explain my apparent craziness. First, I use both Intuit's Quicken and Quicken for Windows. I know Quicken/DOS like the back of my hand; it's fast and easy to use. The newer Quicken/Windows is prettier but slower; worse, its small type on-screen makes chores such as filling in a check a pain.

On the other hand, the printed reports you get from Quicken/DOS are dogs. But Quicken/Windows has access to all the Windows-compatible fonts on your PC, plus the huge advantage of Windows' what-you-see-is-sort-of-what-you-get graphical displays. Quicken/Windows' printed reports can be *beautiful*.

My answer? Use both. *Mirabile dictu*, the good people at Intuit didn't invent yet another new file format for their Windows product: Both DOS and Windows versions of Quicken can read the same files.

So I keep the books in Quicken/DOS, and use Quicken/Windows as a *report writer*—a phrase familiar to users of database programs. Which is what Quicken is.

The result is that I work in a fast, easy style I know well, and I get beautiful, big-business-look financial reports. No more rekeying the



*Sometimes, the best choice
between DOS apps and Windows
apps is no choice at all.*

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Jim Seymour

balance sheet into PageMaker before I see the bankers.

Second example: I use both Microsoft Word 5.0 and Word for Windows 2.0. As much as WinWord 2.0 is an improvement over its first release, and as much as I admire it—I believe it's one of the two or three best applications running on PCs today—it's not nearly as lean, mean, and fast to use as Word 5.0. When I just want to write, that is.

Word 5.0's clean screen, dazzling speed, and intelligent keyboard shortcuts let me get everything computerish out of the way and help me focus on what I'm trying to say, not how it looks. There's no jerky scrolling, no hard-on-the-eyes black-on-white text, no horrible CUA (Common User Access) pull-down menu standards; there is perfectly acceptable page previewing.

In sum, Word 5.0 is a *writing tool*.

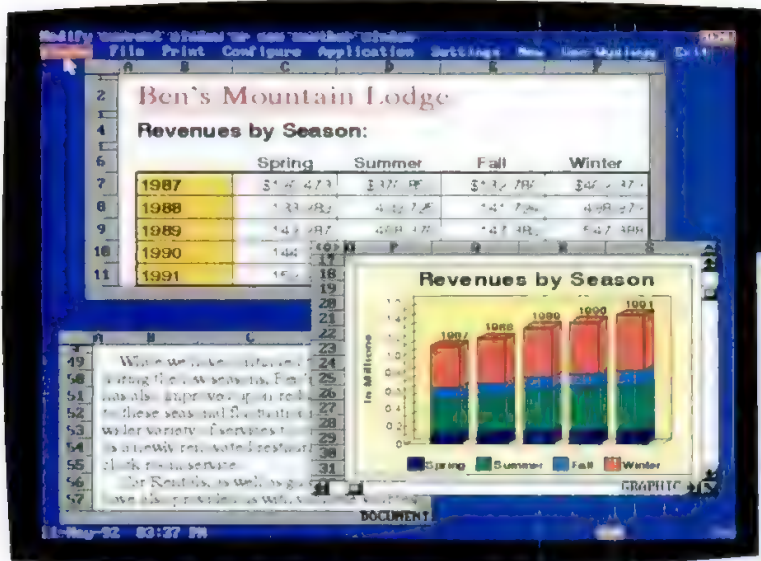
But I sometimes then open a Word 5.0 file in WinWord 2.0 for some clean-ups—often, for major clean-ups. Just as with the Quicken duo, I use the DOS program for speed, comfort, and convenience, and the Windows program when striking appearance is important, too.

Who can afford to buy two versions of a program, you say? Well, for those rooted in the world of DOS, the extra cost is zero. When you upgrade from Word to WinWord, or from WordPerfect/DOS to WordPerfect/Windows (or cross over between the two), it costs zip to keep your DOS program on the machine.

If you're new to the game and don't already have DOS programs for your main tasks, yes, there is additional cost. But Quicken/DOS costs about 40 bucks; add another \$40 for Quicken/Windows and you've spent a very affordable \$80 for bookkeeping software. Word and other applications are different beasts; here, the sums can be more significant.

I'm not suggesting you duplicate all your apps, only those few where it makes sense. And I hardly recommend this for everyone: If you're happy with DOS apps only, or Windows apps only, don't move. I'm not a crusader, you see. Just a pragmatist who wants to get his work done with the best tools for the job at hand. □

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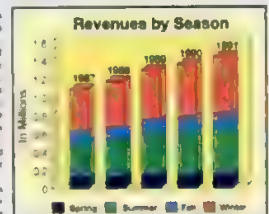
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1991	153,208	511,408	182,388	627,723
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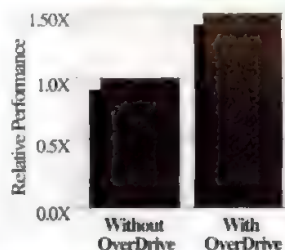
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Beware the Shrink-Wrap Fallacy

As PCs get more powerful, many companies want them to do the jobs that were once the domain of mainframes and mini-computers. But watch out: You could fall victim to the shrink-wrap fallacy.

What's that? The assumption that it's as easy to build systems good enough to run your business as it is to break the shrink wrap on a copy of Lotus 1-2-3 and type A:>INSTALL. It isn't.

Sure, one can often do a lot with relatively straightforward use of shrink-wrap software. Sophisticated systems can sometimes be developed using standard spreadsheet, word processing, database, communications, and other applications.

Let's be careful, though, not to emulate the fellow who thought that because one aspirin could cure a headache, a whole bottle would cure cancer. If we do, we'll not only miss some of our best downsizing opportunities, we may also mess up those we do try.

An information system has a certain life of its own. Choices made early—even those as simple as the format for fields in a database—can have unanticipated consequences. These choices can determine whether some function can be implemented months or even years later. If you represented training received by binary yes/no fields in a personnel database, for instance, you couldn't later determine when training occurred.

That's why real systems analysis is so important. Systems analysis was once not just the next job description after programming. It meant the analysis of relations among sometimes intangible but real elements of complex systems.

The systems analyst must assess the real situation and construct an accurate representation, via programs and data.

In the example of the

personnel database, for instance, representation of each employee can be implemented in many ways with many different software tools. The tools determine how useful and versatile the database will be.

Building such a database under 1-2-3, using simple flag fields for categories such as training received, is likely to impose serious limitations, compared with building one using fully normalized SQL tables.

The easiest implementation for some immediate need may not be best for some future requirement. That can be far from obvious to most casual PC users. The growing range of competing products and standards for database management systems, networks, graphical user interfaces, electronic mail and messaging, multimedia, hardware interfaces, applications programming interfaces, and development tools complicates matters further. Add to that complexity the possibility that some vendors may abandon products or even go out of business.

That's why IS professionals are just as important in the world of downsized, microprocessor-based systems as they were in the old world of mainframes and minis.

That's also why IS professionals in many organizations are gaining a larger role in making PC hardware, software, and networking purchase choices. Individuals' shrink-wrap choices are insufficient to meet corporate systems' needs.

Ultimately, the question isn't just what the user wants. What's more important is what the organization needs. Skilled IS professionals can answer this question best. □



ILLUSTRATION BY TOM LULEVITCH

It takes skilled IS managers to build industrial-strength information systems on micro platforms.

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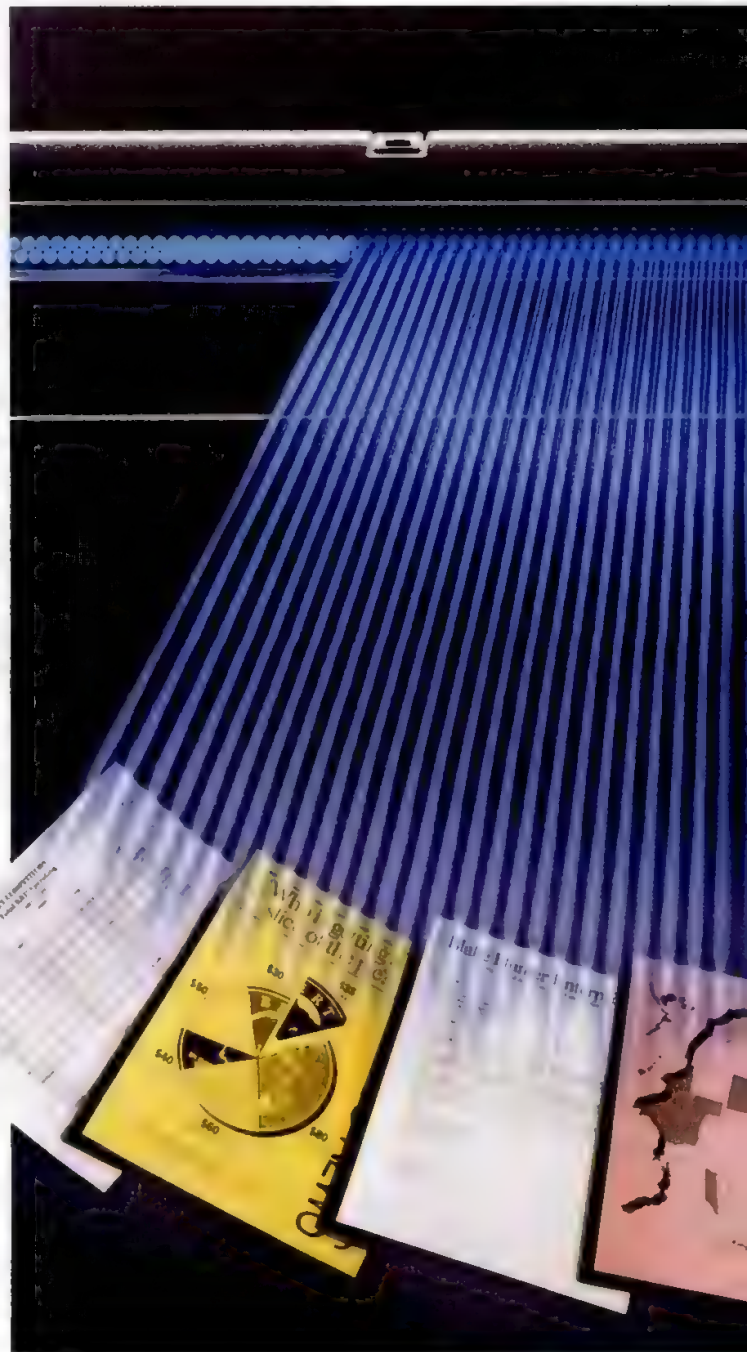
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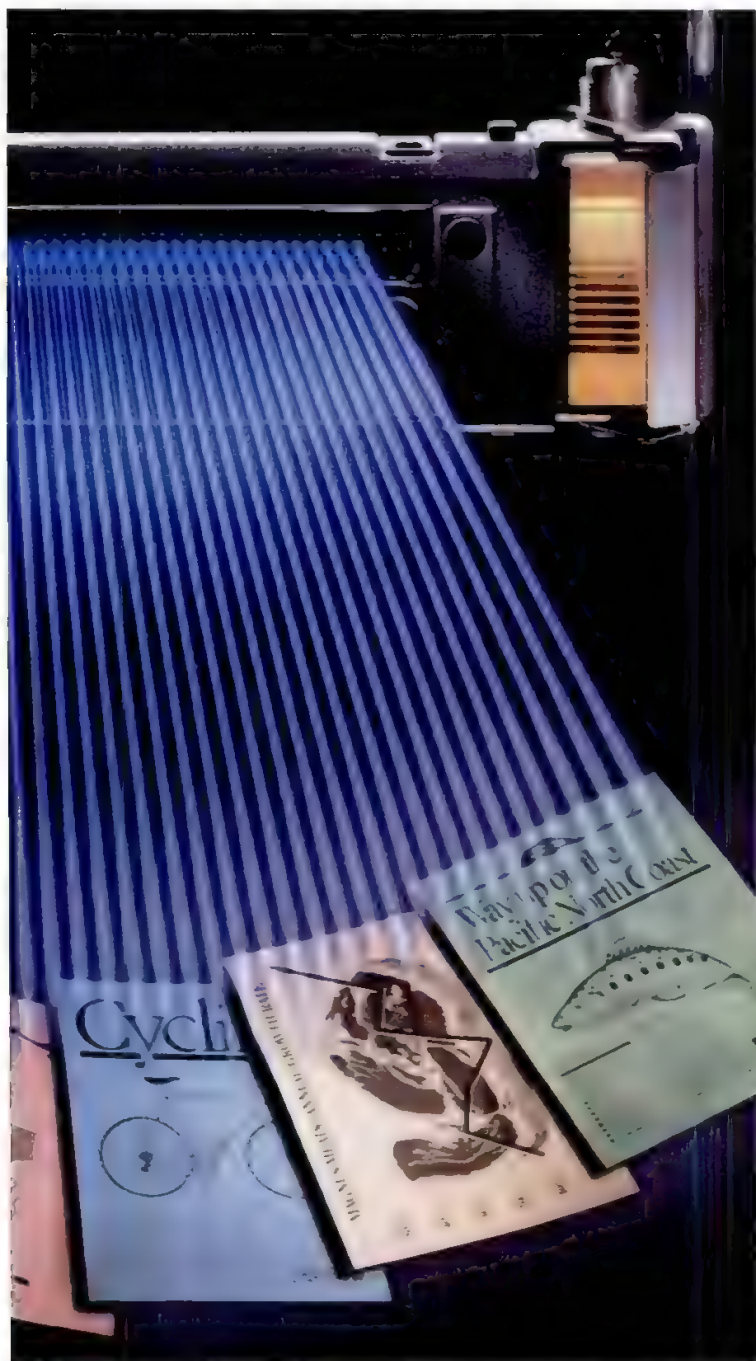
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SPEED-DOUBLED 486s

Intel Ups the Ante with Its 50-MHz DX2

Almost as fast as true 50-MHz 486DXs and available for less than \$3,000, Intel's new speed-doubled DX2s promise to be the next corporate standard, perhaps even signaling the end of the 386 era.

Well, they're finally here. After monumental hype and confusion, the first PCs using Intel's new "clock-doubling" 486 DX2 chips are now shipping. Though at first they may seem neither fish nor fowl—what's their *real* speed, anyway?—the DX2s turn out to be a very good compromise between cost and performance.

So good, in fact, that we think PCs built around 486 DX2s have an excellent shot at becoming the next general-business PC standard, a role played most recently by machines using 386SX and 386DX microprocessors.

Let's clean up the terminology first. That "clock-doubling" stuff is nonsense, a fundamentally misleading term. Nothing in these microprocessors doubles the speed of a PC's internal system clock: It still runs at exactly the same speed it was originally designed to run. The chip itself actually runs at two speeds, the lower of which is determined by the PC's system clock. A 50-MHz 486 DX2 machine, for example, really runs at 25 MHz, and the processor communicates with the rest of the machine at that speed. But internally, the 486 DX2 chip performs its operations at 50 MHz. In effect, it runs twice as fast.

The 486 DX2 processors were designed to drop into the same sockets occupied by standard 486 chips. Pop a 50-MHz DX2 chip into a 25-MHz SX or DX machine and you have a computer that delivers substantially better

by Jim Seymour

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performance. Because of this, PC manufacturers were able to rush this new generation of DX2 machines to market by using existing 486 motherboards and chassis layouts—in most cases with only small modifications, and often none at all. Because the DX2's speed-up is internal, DX2-equipped PCs using FCC Class B—certified designs needn't be resubmitted to the FCC, since system emissions have not changed. That's the kind of design, production, and certification engineering PC vendors love: real gain, no pain, more bucks.

WHAT ABOUT OVERDRIVE?

Intel's smart design work also went part of the way to dissipate those vendors' anger over Intel's nearly simultaneous release of OverDrive, the very similar end-user part designed for 486SX machines and other 486 systems featuring Intel's "vacancy" slot. OverDrive chips use the

same two-speed approach as the DX2, and they plug into the socket next to the original CPU on most of the 486SX machines on the market. Thus, 486SX users can upgrade their existing machines themselves, gaining an instant speed improvement of up to 70 percent—depending on the application—for the \$300 to \$400 street price of that plug-and-play OverDrive chip. And here's the problem that's facing the industry: PC makers don't like it when third parties—especially their microprocessor suppliers—sell performance improvements directly to their customers, particularly when the performance gain is sufficient enough to discourage a PC owner from buying a new

computer for another couple of years.

In addition to some of that vendor anger there is a good deal of confusion in the PC market. The DX2 and OverDrive chips are both speed-doubled 486 processors from Intel; the primary difference is distribution. The DX2 is a manufacturer-installed, time-of-purchase part. The OverDrive is a retail upgrade product, sold directly to end users so they can improve the performance of their existing personal computers.

The OverDrive socket is also a source of some confusion, and that is largely Intel's doing. The OverDrive chip is pin-compatible with Intel's 80487SX part, Intel's original 486SX end-user upgrade path. With the development of the speed-doubling technology, though, Intel has marketed that built-in chip upgradability in different ways. There was the PUS/PES moniker—which stood for "performance upgrade socket," and "processor" or "performance enhancement sockets," respectively—the 487 coprocessor socket, and now the "vacancy" and OverDrive sockets. Well, they're all the same. Now, with vendors providing the zero-insertion-force (ZIF) socket, end users can remove and install CPUs without worrying about damaging these expensive parts. For more on the subject and OverDrive upgradability, see the sidebar "DX2 vs. OverDrive: Do You Want Your Speed Boost Now or Later?"

INTEL'S NEEDS—AND YOURS

The DX2 chips are truly strategic products for Intel. Part of a shower of more than 30 new 386/486-design microprocessors promised this year by Intel CEO Andy Grove, the DX2s are an important part of Intel's strategy for killing the 386 prematurely. That's important to the Santa Clara giant because legal 386 chip clones are now available from several sources. But so far, true 486s are available only from Intel. The company can therefore hold on to its near-monopoly on the middle to high end of the x86 market, with the fat gross margins typical of highly successful single-source products.

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What about the PC buyer's interest? Are DX2 PCs as good for us as they are for the PC makers and for Intel?

In the pages that follow, you'll find reviews of 63 50-MHz 486 DX2 machines, essentially every DX2 machine shipping at the time we prepared this story. In general, we found these DX2-based PCs, doubled from 25 MHz to 50 MHz, perform noticeably better than standard 25-MHz DX machines of the same design and clock speed. Design variations such as use of secondary caches make substantial differences in actual machine-to-machine performance, but in general we found these first 25- to 50-MHz DX2s deliver performance that falls between standard 33-MHz and 50-MHz 486DX designs. Similarly, 50-MHz DX2 prices are on the average about 20 percent higher than those of 25-MHz DXs, and thus fall in between most vendors' 33-MHz and 50-MHz 486DX prices. A closer look shows that Zeos International Ltd. charges a \$100 premium to move from 33-MHz to DX2, and another \$200 to get to true 50-MHz 486DX. Dell's price range is similar: Its DX2 is about \$300 less than its 486/50.

Intel is staking out the highest performance ground with full-speed 50-MHz 486DXs. (Its next processor family, known informally as the 586 or P5, is due out by the time you read this and is expected to be two to three times as fast as 486/50s running at 66 MHz, and eventually 100 MHz). At the same time, it sees the 486DX/33 and the DX2 doubled to 50 MHz and 66 MHz as its midrange desktop part, with the 486SXs forming the desktop entry point for personal computing. And the market for 386-based PCs won't go away quickly; there's lots of value in today's 386SXs, SLs, and DXs, especially as their prices drop like stones to the \$1,200 to \$1,500 level—and soon, under \$1,000. But Intel would love to speed the process.

It seems that Intel's little game is working: 486s are rapidly becoming the new business-computing standard. And the 486 DX2s look as if they're going to emerge as the new midlevel desktop standard.

REVIEW CRITERIA

We asked each vendor to send us a shipping DX2 PC equipped with a 200MB

HIGHLIGHTS

Compaq's QVision Sets the Pace

PC Magazine Labs tested 63 speed-doubled 50-MHz 486 DX2s, our first look at Intel's newest processor family. We were generally impressed by the performance of these systems, but the PCs that feature a well-designed secondary RAM cache really caught our attention. Systems with good cache designs performed almost as fast as PCs architected around Intel's 50-MHz 486DX (96 percent of the processor performance, 79 percent of the memory performance), at a cost savings of two to three hundred dollars typically. We think the DX2 will quickly assert itself as a strong desktop standard in the corporate market.

COMPAQ'S EISA-BASED QVision video adapter sets new standards for video, with its Graphics Winmark score of 19.16 million. It's the new performance standard for the industry to equal, and right now it is twice as fast as the next-best video solution, the ATI Graphics Ultra, which appeared in 3 of the 63 reviewed systems and turned in Winmark scores ranging from 9 to 10 million. Also performing well under Windows were the 31 S3-based systems, whose scores were in the 6 to 8 million range on this test.

THE ALTEC 486DX2 Local Bus showed us that its local bus can provide fast video performance under Windows (Graphics Winmark score: 8.46 million), while keeping its price under \$2,800. The PCs from Ares and Swan also contained S3-based local-bus systems, but neither delivered the price/performance of the Altec.

THE CLOVER 486 EM II featured a very fast cached 32-bit EISA Mylex SCSI controller with 4MB of hardware cache and a 15-ms. Maxtor SCSI hard disk. This souped-up desktop with its large cache was enough to

blow away our disk test, but the package is expensive—\$4,995. The same is true of the Mylex controller/Western Digital SCSI hard disk combination found in the \$4,895 Tangent Model 450ex.

THE FUTURETECH System 452E, with its tower case on casters, nine drive bays, EISA expansion, and its rocket-fast 4MB cached AMI EISA-controller/340MB Fujitsu SCSI-2 hard disk combination, is an obvious low-cost file server at \$4,629.

ACER'S CHIPUP motherboard design proved itself a good performer. Intelligent motherboard engineering lets Acer use the same design for both 386 and 486 CPUs, but we didn't like seeing a disabled 386 still inside the PC and a 386 label on the case. We don't expect that users will receive a system with two CPUs, however.

DIGITAL'S OWN 852MB SCSI hard disk, rated at 9.5 milliseconds, stood out from all the 200MB units we asked for (as did the DECpc 450ST's 32MB of installed RAM), but without any cache assistance, the hard disk's performance was unexceptional.

hard disk, 4MB of RAM, 800-by-600 resolution with 256 colors, DOS 5.0, and Microsoft Windows 3.1. We asked for EISA-bus designs when they were available; in the end, of the 63 systems in our test group, 34 were ISA, 27 were EISA, and 2 were Micro Channel architectures.

We received 65 systems, but 2 vendors were unable to provide fully functioning systems during our test period in early

June: Tandy's PC had hard disk problems that we could not resolve, and the unit Master Computers sent us was a true 50-MHz 486DX, not a speed-doubled 50-MHz system. The company did not have its DX2 product available in time for our review. The 63 DX2/50s covered in this roundup include systems from Acer America Corp., Arche Technologies, AST Research, Austin Computer, Club Ameri-



EDITORS' CHOICE

- **Advantage 486 DX2/50**
- **Compaq Deskpro 50M**

The combination of fast performance and low cost makes PCs based on Intel's 486 DX2 chip *PC Magazine's* choice as the next desktop standard for corporate computing needs. Given the intense price competition in the PC market, a host of speed-doubled 486s with a workhorse 4MB of RAM, EISA configurations with 200MB hard disks will soon be available for \$2,500 or less. While several of the systems we reviewed offer great performance or value, the choices quickly narrowed to two systems that stand apart from the rest of the crowd. In the desktop category, no system could touch the performance, quality, and flexibility of the Compaq Deskpro 50M. Compaq offers five EISA slots (four are open) and six drive bays in the rugged, CPU-upgradable chassis. The only problem is the system's \$4,897 price, but that should continue to spiral downward this summer. The other outstanding DX2 is a tower system, Standard Computer's Advantage 486 DX2/50.

The biggest news in this story, besides the performance of Intel's speed doubler, is the Compaq's remarkable video. Called QVision, Compaq's own video adapter turned in a Graphics Winmark score of 19.16 million. This score is almost double that of the 9.71 million Winmark score of its nearest video rival, an ATI Graphics Ultra in the Advantage. The Compaq's score on our DOS-based video benchmark test was also excellent, placing second of the 63 systems. While most of the video chip sets we've tested perform well either under DOS or specifically under

Windows, Compaq's engineers have designed a system that is good in both video categories. Compaq also sells the QVision card separately for \$599 in EISA and ISA versions (we tested the former). The adapter currently is without peer.

The other Editors' Choice in this field, the Advantage, sells for \$3,275 with 4MB of RAM and a 240MB hard disk. But Standard doesn't stop there: The Advantage also comes with a mouse, a fax modem, DOS 5.0, Microsoft Windows 3.1, and Norton Desktop for Windows 2.0. This strong bundle complements an excellent EISA tower system. With the second-fastest Graphics Winmark score (thanks to a 1MB ATI Graphics Ultra adapter), an optional 535MB hard disk, seven drive bays, six open slots (four are EISA), and strong performance on our other benchmark tests, Standard has a PC usable either as a power user's dream system or as a low-cost file server. And unlike too many of its more affordable competitors, Standard pays careful attention to detail, including complete and accurate documentation.

HONORABLE MENTION

In addition to our two winners, we've selected four systems that also deserve

recognition as better than the rest. Honorable mentions go to Polywell Computers' small-footprint Poly 486-50DX2, the Ariel 486DX2-50 mini-tower, and the FutureTech System 452E and Tri-Win 486 DX2-50 EISA tower PCs.

The \$3,650 Poly offers significant expansion in a case that won't claim your desktop. Offering support for 128MB of system RAM, five free EISA slots, and five drive bays for disk storage, this PC is no lightweight.

The ISA-bus Ariel is a fast performer that is well-constructed and fairly priced at \$2,695. In a field of look-alikes, its speed-doubled 486 stands out for its consistency: good speed, good build, good price, and good support. Its mini-tower case offers six drive bays, six free ISA slots, and an optional 520MB hard disk. While the Diamond SpeedSTAR adapter wasn't as fast as the accelerated video chip sets under Windows, Ariel Design ships this PC with a 32,000 color driver for Windows.

If you need a low-cost EISA file server, the Tri-Win, available for \$2,795, is a worthy choice. This tower unit offers five open EISA slots, eight drive bays, and some of the best price-performance found in this roundup. Much of that comes from a 15-ms 212MB SCSI-2 Maxtor hard disk and DTC disk controller with a 2MB disk cache. The Tri-Win performed consistently well on all of our benchmark tests, has room for eight drives, and comes with a two-year warranty.

The final honorable mention goes to the FutureTech. This tower has eight EISA slots (five are open) and can also house up to nine hard disks. It costs a bit more than most (\$4,629 with 4MB of RAM) but has great disk performance,

can, Compaq, Compudyne, Dell, IBM, NCR, NEC, Northgate, Standard, Swan, and Zeos.

BUT HOW FAST ARE THEY?

In many ways, the diversity of designs and engineering approaches we saw reflected the diversity of standard 486DX machines we have seen earlier. It's clear that some PC vendors have taken literally Intel's

suggestion about dropping 486 DX2 chips into familiar 25-MHz and 50-MHz DX designs. But others are using the DX2 rollout as a chance to implement new, enhanced feature sets and higher-level technologies in supporting subsystems such as disk controllers, video adapters, and secondary processor caches. We also saw substantial performance differences, depending on how the DX2 chips were used.

For example, the use of a secondary processor cache—preferably 128K or larger—to support the DX2's own 8K on-board cache made a big performance difference. All but eight of these DX2s used external caches. Most used 256K cache designs, but some used only a 128K or 64K cache, and one machine, the Epson Equity 486DX2/50 Plus, had only a 32K cache. Tellingly, the Epson was the slowest

thanks to a larger-than-most 340MB SCSI-2 Fujitsu hard disk combined with a 4MB-cache AMI 32-bit EISA caching disk controller. The FutureTech is big and fast, and for what you get in return, this solid high-capacity EISA file server is a real value. (FutureTech Systems also provides disk options up to 1.2GB.) This PC is available through dealers, so look for discounts.

DESERVE A LOOK

In addition to the two Editors' Choice and four honorable mention 486 DX2/50 systems, PC Magazine Labs identified four other PCs with a price-performance mix substantially better than the norm. You should be happy with any of them. The \$2,990 Austin 486 WinStation DX2-50 offers good graphics, six EISA slots (four open), and four drive bays inside what should be a quality corporate workstation. The \$2,995 Matrix 486-50 DX2 is a low-cost, small-footprint desktop for those willing to accept ISA to get the most power for the lowest price. Matrix Digital Products provides very good expansion (five drive bays, six open slots), quality brand-name components, and a bevy of hard disk choices, all of which make this a system worth considering. You may also consider the Flex 486DX2/50 System, from USA Flex. For a modest ISA desktop, it's a bargain at \$2,499 with good technical support and service.

In the tower/server category, the \$3,080 Club Falcon 450 DX2 offers above-average performance in a solid ISA tower that is processor-upgradable. Expansion possibilities include up to 64MB RAM, a 1.2GB hard disk option, seven drive bays, and five open ISA slots.

in terms of processor speed, both cached and uncached.

On our tests, machines with caches larger than 128K showed relatively little improvement over those with 128K designs. That's partly because our test suite incorporates a 128K No-Operation task, which penalizes machines with smaller caches while hardly emphasizing improvements shown by larger caches. But

this isn't only a testing phenomenon: There is always a point of diminishing returns with caches, and once you get past 128K, the increase in the cache's "hit rate" is slight compared with the gains in that first 128K.

Just how important is an external, secondary processor cache? So important that PC Magazine Labs found DX2s with a well-designed 128K (or larger) cache run at 96 percent the processor performance level of a 50-MHz 486DX. Memory calls go outside the DX2's 50-MHz world, so we saw a drop-off to 80 percent of true 50-MHz system performance; your actual performance should be in between, and the difference is nearly unnoticeable if you're not performing memory-intensive tasks, like large spreadsheet recalcs. In that context there's a bigger difference, to be sure, but the real story is not that these DX2 machines are a little slower than the DXs, but that the two classes of computers are so *close*.

These machines also used a variety of hard disk controllers, from IDE (46 systems) to SCSI (15 systems) to ESDI (2 systems). The Clover 486 EM II went all the way, with Mylex's 4MB caching ESDI controller driving a 213MB Maxtor hard disk. The combination turned in the best disk access time of any machine in the group. Many makers used the Quantum ProDrive LPS-240 IDE hard disk, with its integrated electronics and on-board 256K disk cache. These IDE units may not match the other systems for raw speed, but the Quantum hard disk's built-in cache provides very respectable access times.

FASTER VIDEO

A larger issue in performance is the use of local-bus video in DX2 machines. Our tests found much less improvement in display speed than we expected in the two local-bus machines we tested. In practice, separating video processing and jamming it through a 32-bit direct local-bus design ought to have given them a big leap in video performance. Yet the Swan 486DX2-50DB and the Ares 486-50DX2

Sonic III, with proprietary local-bus video, came in only ninth and tenth (with Graphics Winmark scores of 7.88 million and 7.87), respectively, among these machines in terms of Windows video performance. Both systems also had DOS-based video scores well back in the pack.

Why? The S3 chip set implemented by these two PCs for local-bus video isn't optimized for direct video. It's also a matter of the relatively slow Windows video drivers shipped with these machines. A better, more up-to-date video chip set and

higher performance, more robust Windows 3.1 video drivers could—and should—push the Swan and Ares machines over the top in display performance.

For now, the top slot in video performance is claimed by the Compaq Deskpro

50M, which uses the company's proprietary QVision design, implemented here on the EISA bus. A Winmark score of 19.16 million for the Compaq was twice as fast as the next-best machine and 20 times as fast as the lowest-rated of these 486 DX2s. On this test, most of the PCs with ATI Graphics Ultra boards scored around 9 million, those with S3 boards scored between 6 to 8 million, and Tseng ET4000-based PCs produced scores around 2 million.

Remember that speedy Windows video performance counts only if you use Windows and Windows applications all or almost all of the time. And few machines provide top-level video performance under both DOS and Windows. The ATI Graphics Ultra card in the ACMA 486DX2/50, for example, produced a high Winmark score, but it was in the middle of the pack for video performance under DOS. Conversely, the AST Power Premium 4/50d, which provides Super VGA video on the motherboard via a Western Digital chip set, had a dazzling DOS video speed but only middling Windows video performance. (The DOS-based video test best demonstrates the all-purpose hardware performance characteristics of the video chip set—independent of video drivers.)

If top-drawer video performance in

*The real story is not
that DX2 machines
are a little slower than
DXs, but that the
two are so close.*

■ Price/Performance Index: 50-MHz 486 DX2s

This tightly bunched group of speed-doubled 486s offer tremendous bang at an affordable price, with the sweet spot in the top-right quadrant (lowest price and best performance) dominated by ISA-bus systems featuring S3's accelerated video chip set.

PCs from Axik, C², and Micro Express combine an ISA bus and S3 video, which yield the optimal price/performance ratio, but none of these systems distinguished itself as Editors' Choice material when we considered such factors as construction, documentation, and support. The same is true of the low-cost EISA systems from Eltech and NETiS: They offer great price and solid performance but questionable value and tech support.

Offering a little less performance but better value and construction in an ISA desktop is the Ariel 486DX2-50, with its Quantum ProDrive cached IDE hard disk for under \$2,700. Outstanding EISA values include the Tri-Star (\$2,795), with its great

disk performance (a 2MB cached Maxtor SCSI hard disk) and generous expansion in a roomy file-server case; the Standard Advantage (\$3,275), with its ATI Graphics Ultra board and fast Quantum ProDrive; and the EPS (\$2,995), whose vendor settled for Tseng 4000-based video to keep costs down in an otherwise high-value, expansive tower case.

Systems that offer superior performance at an above-average price include the EISA-based Compaq, which achieved a Graphics Winmark test score of 19 million. The Compaq is the video star of this story, while the Tangent combines a Mylex 32-bit EISA cache controller (4MB of RAM) with a fast Maxtor SCSI hard disk to lead this pack of 63 systems in disk performance.

Digital manages to fall off our graph, since the test system it submitted included 32MB of RAM and an 852MB SCSI-2 hard disk rated at 9.5 milliseconds—well above the 4MB of RAM, 200MB systems we requested. IBM's \$10,000-plus price left it out of the picture, even after we factored in dealer discounts.



THE DATA POINTS

The performance/features axis of the Bang for the Buck chart is based on 11 data points: the five PC Magazine Labs benchmark test scores, maximum installable RAM, disk capacity, VGA RAM, free slots, drive bays, and extras (miscellaneous items such as free bundled software, a mouse, on-site service, FCC Class B certification, an extended warranty policy, a 16550 UART, flash memory, and the availability of a 2.88MB floppy disk drive). We have applied a set of weighting

factors to the raw numbers; performance and features each make up half the score. You can find this data in the Software Library of PC MagNet's Editorial Forum as 15BANG.WK1.

The tested-configuration price (as listed in the fact file) determines each system's location on the y-axis. We applied a 15 percent discount to the list prices of dealer-distributed systems to approximate street prices.

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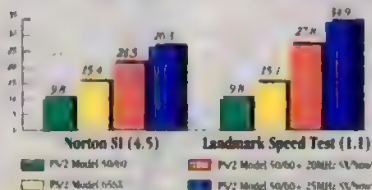
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Recent Reviews: 50-MHz 486DX PCs

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■—Editors' Choice

both Windows and DOS are important to you, look carefully at Compaq's PC. Compaq even sells the card for \$599 in both EISA and ISA flavors, if you don't need (or can't afford) the entire Deskpro. Not only did its QVision system far exceed the other machines' Windows performance, it came in second on our video test. The Compaq's Conner hard disk has mediocre access times, but its balanced video performance makes for a superb if expensive machine.

FINDING THE RIGHT SYSTEM

As usual, these systems displayed a wide range of personal-preference configuration choices. The choice between a desktop and tower-design chassis is easy, depending on your needs and workspace. Less obvious are tradeoffs on the number of expansion-bus slots and the number of half-height drive bays.

If you're looking for a highly expandable network server among these machines, for example, the wide-open expansion potential of the FutureTech System 452E will appeal to you. A speedy EISA machine with a big, fast 340MB Fujitsu hard disk driven by an EISA-slot

controller with 4MB of disk cache, the FutureTech has plenty of muscle. But it also backs up that raw performance with nine drive bays (five accessible 5.25-inch and four internal 5.25-inch, one of which can be full-height), and eight EISA expansion slots (five of which are free), all packed into a roomy tower-style case equipped with dual fans for system cooling and casters for easy moving.

Among the small-footprint desktop designs, the Compaq is the clear winner on performance, though at a list price of almost \$5,000, it costs a good deal more than other compact machines reviewed here. Remember that all small-footprint designs involve some compromises in expandability, both in expansion-bus slots and drive bays. Nevertheless, in single-user workstation roles, speedy designs like those from AST, Compaq, and others here may more than make up in convenience what they lack in expandability.

Some of the faster EISA-bus desktop machines reviewed here may at first look like good bets for network servers. But we find it hard to recommend a desktop chassis for server use; you simply give up too much expansion potential—as well, usually, as put up with inconvenient access to expansion cards and drive bays, marginal cooling, and inadequate power supplies.

Who should buy these first DX2 machines? They are a good investment for anyone interested in near-state-of-the-art performance, with an emphasis on the *near*. Although faster DX2 chips will be available soon, these first-generation DX2s offer respectable to dazzling performance, and a year or two from now, they'll still be impressive. Over a typical corporate three-year life cycle for desktop computers, the 50-MHz 486 DX2s represent a good value for your money.

For individual users with champagne tastes but beer budgets, the DX2s are an especially good bet. You'll give up little performance compared with the fastest PCs sold today—50-MHz 486DX designs—while gaining access to features

such as the EISA bus, local-bus video, and caching disk controllers. And, of course, prices that are significantly lower than 50-MHz DXs.

Later this year we'll see the first machines built around Intel's P5, or 586, processor. Machines using these wonder chips will surely steal the thunder from today's top-of-the-line 486DX-based CPUs. That will leave these DX2 PCs in an even more prominent position: well-placed in the upper-middle performance range, but at prices dramatically lower than the state-of-the-art boxes.

They have a long and happy life ahead of them.

Acer America Corp.

AcerPower 486DX2/50 WU

There's one in every crowd. Not content to implement Intel's version of the single OverDrive chip upgrade, Acer America Corp. has gone ahead and invented the ChipUp technology—a proprietary single-chip upgrade design that accepts processors up to the 486 50-MHz range. But though this technology is nifty, it still boils down to reasonable 486 DX2 50-MHz performance on an old-fashioned ISA bus for a stratospheric \$6,195 price.

Though Acer says that the ChipUp design has been around for a year, it was ob-

viously just being implemented for the AcerPower 486DX2/50 WU when our test unit was shipped. Both the system documentation and the all-plastic desktop case were labeled the "AcerPower 386/33W." Once open, even the motherboard bore



PRODUCT PHOTOGRAPHY BY THOM O'CONNOR

witness: An inert 386 processor was still soldered in place next to the 486 DX2-occupied upgrade socket. A chip set made by SIS handles the task Acer engineers vaguely described as "386-to-486 translation," which apparently involves 486 memory functions such as the burst mode necessary to communicate most efficiently between the processor and the external RAM cache.



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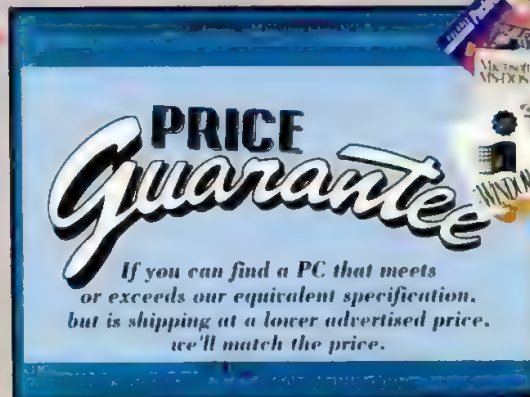


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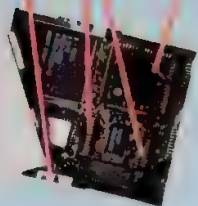
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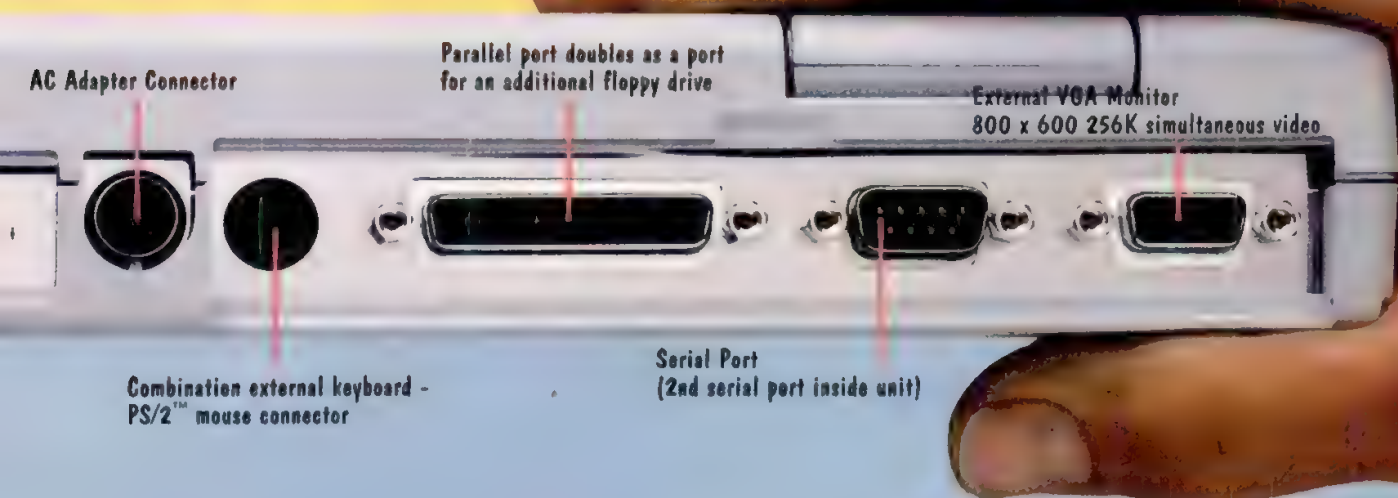
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AcerPower 486DX2/50 WU

Acer America Corp., 2641 Orchard Pkwy.,
San Jose, CA 95134; 800-733-2237,
408-432-6200; fax, 408-433-3622

List Price (Tested Configuration): \$6,195

Memory and processor RAM cache: 4MB 80-ns
SIMMs, 256K cache

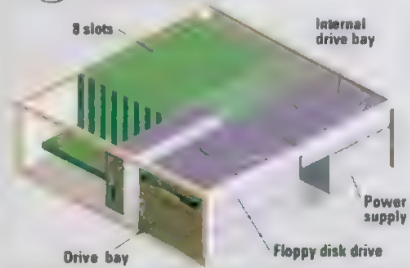
Disk drives and controller: Conner 12-ms 212MB IDE
hard disk, UltraStor controller, 2MB cache, 1.2MB and
1 44MB floppy disk drives

Display: ATI 1,024-by-768 adapter with 1MB RAM, Acer
14-inch monitor, 60-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1

In Short: The AcerPower 486DX2/50 WU's excellent
performance and ChipUp upgradability is compromised
by a high price

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The unit contained six drive bays, four of which were front-accessible: three 5.25-inch half-heights and one vertical 3.5-inch half-height. Two internal 3.5-inch horizontal half-heights were mounted on top of the 200-watt power supply. The AcerPower ships with 4MB of RAM (64MB maximum) accompanied by a 256K, 25-nanosecond, look-aside, direct-mapped, buffered write-through processor RAM cache, and a Conner CP-302066 212MB IDE hard disk connected to an UltraStor 15C 16-bit controller with 2MB of cache.

Video was based on ATI's 1MB Graphics Ultra accelerator card paired with Acer's own 14-inch AcerView 35 Super VGA 1,024-by-768 monitor.

Acer's proprietary ChipUp technology didn't get in the way of performance, since both the processor and memory

scores were highly competitive. The unit placed second on our processor test and fifteenth on our memory test. Its Windows scores were also top-rung. Thanks to the ATI Graphics Ultra, the AcerPower placed fourth with a Graphics Winmark score in excess of 9 million.

Acer ships the AcerPower 486DX2/50 WU with a one-year parts-and-labor warranty and maintains a toll-free technical support number. Interlogic-Trace provides on-site service free for the first year.—*Oliver Rist*

ACMA Computers Inc.

ACMA 486DX2/50

In our tested configuration, the ACMA 486DX2/50 lists for \$3,995. It came with 4MB of RAM, a Quantum 240MB IDE hard disk, and a good video display that paired an ATI Graphics Ultra adapter with a NEC MultiSync 4FG 15-inch monitor. This solid EISA-bus desktop offers moderate expansion room and is backed by a fine service-and-support mix.

The ACMA's motherboard, manufactured by Helm Engineering, carries an Award ROM BIOS and an Intel chip set. Memory is aided by a 256K direct-mapped buffered write-through secondary SRAM cache. Video was based on an ATI Graphics Ultra card with an ATI Mach 8 video accelerator chip set and 1MB of video RAM. The accelerated graphics card was paired with a high-quality 15-inch NEC MultiSync 4FG monitor that featured a 70-Hz refresh rate at 1,024-by-768 resolution.

Performance was outstanding on our Graphics Winmark test, where the ATI Ultra card placed third. Considering that most video subsystems

with graphics accelerators fare relatively poorly under DOS, its twentieth-place score on our DOS-based video test was respectable. The 256K RAM cache yielded midrange processor and memory scores, attesting to the fact that performance under a 256K cache is not neces-

sarily greater than under a 128K cache. On our disk test, the unit placed twenty-sixth out of the 63 systems we looked at. Its 15-millisecond 240MB Quantum LPS240A IDE hard disk came bundled with Quantum's Segmented DisCache—a 256K read-ahead cache—and was managed by a DTC-2290 controller on a plug-in board.

SIMM sockets on the motherboard hold the system maximum of 64MB RAM. Expansion room, typical for a full-size desktop system, consists of eight EISA slots (five of which were empty in our test unit) and five drive bays. Three 5.25-inch bays accept removable media; two 5.25-inch bays are internal. While no particular feature stands out, the ACMA's rugged, well-finished case and a good selection of quality components inspire confidence.

ACMA sells computers by mail-order. The standard parts-and-labor warranty is for one year. On-site service with TRW is free for the first year. An 800 technical support telephone number is available from 7:00 to 6:00 Pacific time.

—*Bruce Brown*

FACT FILE

ACMA 486DX2/50

ACMA Computers Inc., 48501 Warm
Springs Blvd., Fremont, CA 94539; 800-786-
6888, 510-623-1212; fax, 510-623-0818

List Price (Tested Configuration): \$3,995

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 256K cache

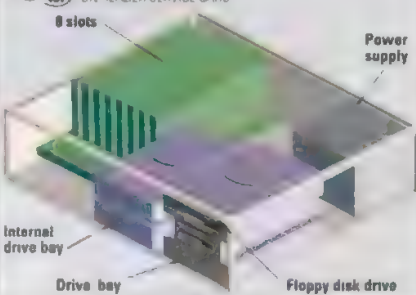
Disk drives and controller: Quantum 15-ms 240MB
IDE hard disk, 256K cache, 1.2MB and 1 44MB floppy
disk drives

Display: ATI 1,024-by-768 adapter with 1MB RAM, NEC
15-inch monitor, 70-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1

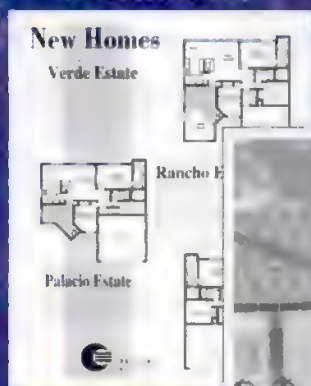
In Short: The ACMA 486DX2/50 is a solid but unexciting
EISA desktop sold via mail-order

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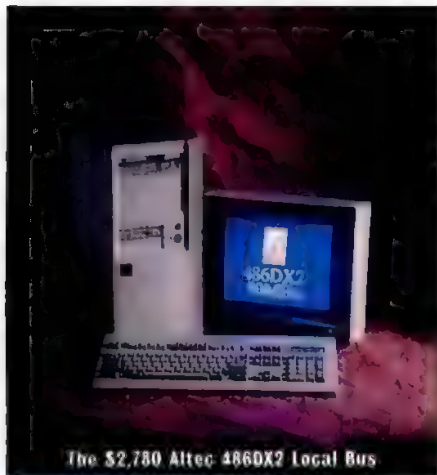
Altec Technology Corp.

Altec 486DX2 Local Bus

The \$2,780 Altec 486DX2 Local Bus is about as unexceptional as its name. "Local bus" is all that stands out. What must have been on Altec's mind was price: Our test unit was one of the more inexpensive of this roundup. If typical 486 50-MHz speed is enough for you (and that's not slow!), then you should be more than happy with this choice.

Our test system came with an AMI BIOS, a Gigabyte motherboard, and 4MB of RAM (32MB is the maximum). The hard disk was a 15-millisecond 212MB Maxtor unit (437MB and 678MB sizes available), but its BusTek BT-5425 controller had no cache memory or buffer. The unit's Intel 486 DX2 has no heat sink but runs with a 256K 25-nanosecond direct-mapped write-back secondary cache. The video subsystem uses a 32-bit Gigabyte GA-300 local-bus video accelerated by an S3 86C911 chip set with 1MB of video RAM. Our system included a 14-inch ViewSonic 5E monitor with a 72-Hz refresh rate at 1,024-by-768 resolution.

A sturdy 25.6- by 8- by 17.5-inch mini-tower case with neatly arranged cables, the Altec has five front-accessible drive bays. Though it has seven full-length ISA slots, an unfortunate I/O arrangement (two parallel, one serial, and one game



The \$2,780 Altec 486DX2 Local Bus

port) takes up two of them. Since the case has openings for I/O, running the ports off the motherboard would have saved slots.

Altec Technology Corp.'s first arrival at PC Magazine Labs would not load Microsoft Windows 3.1 properly, but its re-

FACT FILE

Altec 486DX2 Local Bus

Altec Technology Corp., 18555 E. Gale Ave., Industry, CA 91748; 800-255-9971, 818-912-8688; fax, 818-912-8048

List Price (Tested Configuration): \$2,780.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache.

Disk drives and controller: Maxtor 15-ms. 212MB SCSI hard disk, BusTek controller, 1.2MB and 1.44MB floppy disk drives.

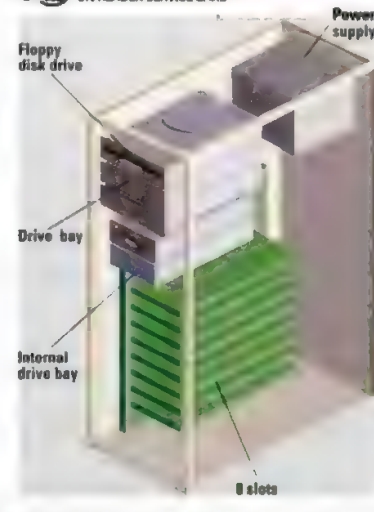
Display: Gigabyte 1,024-by-768 local-bus adapter with 1MB RAM, ViewSonic 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: This aggressively priced PC has fast local-bus video for Windows, but its disk performance is poor.



ON READER SERVICE CARD



placement ran without problems. The S3 local-bus implementation was sixth-fastest on our Graphics Winmark test; DOS performance was fair. This system used the Maxtor LXT213SY SCSI-2 hard disk, but without the added benefit of a cache, its disk performance was poor.

Altec offers a two-year warranty on parts and labor. On-site service from TRW is free the first year, though Altec accepts units for repair. Technical support is toll-free.—OR

Amax Engineering Corp.

Amax 486DX2 Power Station

The \$3,478 Amax 486DX2 Power Station is so average and devoid of surprises, it should prove a reliable buy.



The \$3,478 Amax 486DX2 Power Station

The Amax came dressed in a somewhat flimsy 6.5- by 21- by 17-inch full-size desktop case with three half-height 5.25-inch and two 3.5-inch front-accessible drive bays. The Amax motherboard had an Award BIOS and contained eight full-length EISA slots. Our test unit's 4MB of RAM was expandable to 64MB, but one shortcoming was the space allocated to memory: The two leftmost drive bays and their retaining bracket must be removed in order to access the SIMM slots. This

FACT FILE

Amax 486DX2 Power Station

Amax Engineering Corp., 47315 Mission Falls Ct., Fremont, CA 94539; 800-888-2629, 510-651-8886; fax, 510-651-3720

List Price (Tested Configuration): \$3,478.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache.

Disk drives and controller: Quantum 15-ms. 240MB IDE hard disk, UltraStor controller, 1.2MB and 1.44MB TEAC floppy disk drives.

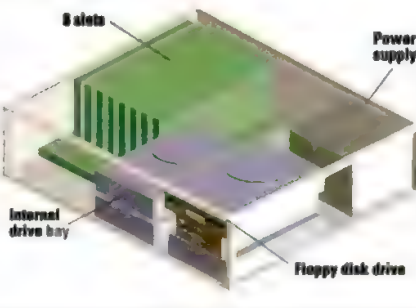
Display: Diamond 1,024-by-768 adapter with 1MB RAM, Impression 14-inch monitor, 70-Hz refresh rate.

Software: DOS 5.0.

In Short: The Amax 486DX2 Power Station is a reasonable performer with standard off-the-shelf parts at a moderate price.



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entails dismantling the hard disk and disconnecting the power supply. The rest of the board was fine, however, complete with a heat sink for the Intel 486DX2/50 processor and a 256K 25-nanosecond SRAM direct-mapped buffered write-through secondary RAM cache.

To its credit, the components were top-quality standard parts, including a 240MB IDE Quantum hard disk with an ISA 16-bit UltraStor 15C IDE hard disk adapter. Video was based on a Diamond Stealth VRAM video card equipped with an S3 graphics accelerator and 1MB of video RAM. The only letdown was the Helm Engineering CM1448M monitor. Besides being frighteningly flimsy, it had rear-mounted knobs for vertical phase and horizontal/vertical positioning, though the controls for power, brightness, and contrast were in front.

Except for scoring in the top 25 percent on our disk test, the Amax stayed consistently within the average for this group. The S3 graphics accelerator delivered characteristically good performance under Windows but didn't do as well under DOS.

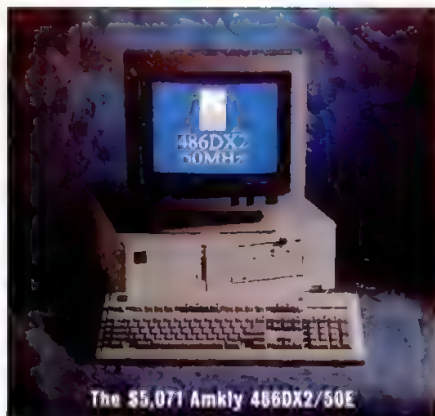
Amax sells the system both directly and through dealers and includes a one-year parts-and-labor warranty with on-site service available through TRW. Technical support is available only through a BBS.—OR

Amkly Systems Inc.

Amkly 486DX2/50E

The \$5,071 Amkly 486DX2/50E has a beautiful design marred by a high price tag and dismal performance. Considering the obvious thought and caring that went into this system—as well as its luxury price—Amkly would do well to optimize the base-priced system to the requirements of each CPU—not to mention the end user.

Opening the uniquely designed, small-footprint Amkly case is a pleasure not just because of what you'll



The \$5,071 Amkly 486DX2/50E

FACT FILE

Amkly 486DX2/50E

*Amkly Systems Inc., 60 Technology Dr.,
Irvine, CA 92718; 800-367-2655,
714-727-0788*

List Price (Tested Configuration): \$5,071.

Memory and processor RAM cache: 4MB 70-ns. SIMMs.

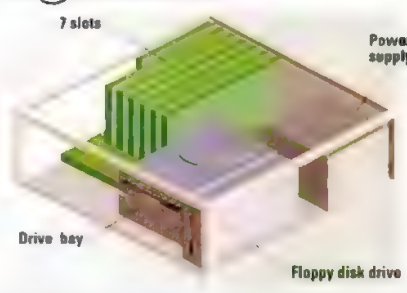
Disk drives and controller: Seagate 24-ms. 397MB ESDI hard disk, UltraStor controller, 1.2MB and 1.44MB floppy disk drives.

Display: 1,024-by-768 adapter with 1MB RAM, Amkly 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The Amkly 486DX2/50E has a beautiful ergonomic design, but lack of a processor RAM cache compromises its performance.

ON READER SERVICE CARD



find, but because of the two rear-mounted thumbscrews that make entry so easy. Since the 200-watt power supply and drive bay module can be disassembled by removing only one screw, achieving unlimited access to the motherboard is simple.

The Amkly's motherboard is equally well finished. It has seven EISA slots with only two occupied, one by the upgradable CPU module with heat sink, another by the UltraStor 22CA EISA ESDI hard disk controller (complete with a 4MB

RAM cache). The unit's 4MB of RAM, located on the CPU module, is expandable up to 64MB. Our test unit also had a Seagate 2383E 397MB ESDI hard disk and system board video circuitry based on a Trident 8900C chip set and 1MB of video RAM. All I/O

What the

Of the 63 systems tested here in our first review of systems featuring Intel's 50-MHz 486 DX2 speed-doubler technology, 34 used the ISA I/O bus architecture, 27 used EISA, and 2 systems (the IBM PS/2 Model 95 XP 486 25/50 and the NCR System 3335) used MCA-based architectures.

All but 8 of the systems had second-level processor RAM caches to augment the 486's internal 8K cache (31 systems featured 256K caches, 14 had 128K caches, and 10 used 64K caches). One, the Epson Equity 486DX2/50 Plus, had only a 32K cache; its processor benchmark test score of 343 operations per second was the lowest turned in by a system with an external cache. The processor test includes a 128K No-Operation task, which is particularly severe on those systems that don't have at least a 128K cache. The average processor score for the 18 systems that either had no external cache or had one with less than 128K was 407 operations per second—17 percent below the general average of 485 operations per second. While systems with larger, better-optimized caches will perform better than those without, we feel our current tests are too severe on systems with 32K and 64K caches. Their real-world performance will not be as seriously affected.

WHAT ABOUT TRUE 50-MHz 486s?

Processor performance in general provides insight on how these clock-doubled systems measure up against a true 50-MHz Intel 486DX. Having determined the performance points for the DX2s, we went back to the results for 19 486/50s that PC Magazine Labs tested in our issue of June 16, 1992. All of those systems used a 128K secondary cache or larger and scored an average of 514 operations per second on our processor test. Considering only those DX2s that feature at least a 128K cache, we found that the average DX2/50 performed at 96 percent of the speed of the average DX/50 (505 versus 525 operations per second).

Numbers Mean: 486 DX2 PCs

On the average, the 63 DX2 systems performed at 92 percent of the speed of the DX/50s on this test.

While the internal processor operations take place at 50 MHz, the other operations take place at 25 MHz. The average memory performance for all the DX2s was 6,314 kilobytes per second (compared with 8,017 KBps for the DX/50s)—78 percent of the performance of true 50-MHz systems. A common denominator was the upgradable Compaq Deskpro 50M. It turned in a processor score of 524 operations per second when using a DX2, and the DX/50 version scored 529 operations per second; memory scores were 7,760 KBps as a DX2 and 9,903 KBps as a DX/50.

The reasonable conclusion: Under most applications, PCs utilizing the clock-doubler technology should perform nearly on the same level as a true 50-MHz 486 when the DX2 chip is used with an appropriately designed external cache. Memory-intensive work will suffer, since memory accesses leave that fast 50-MHz world inside the CPU and venture onto the memory bus at 25 MHz.

DISK

Except for those PCs that used caching disk controllers to maximize EISA's 32-bit capability, PC Labs' disk test showed little notable difference among ISA, EISA, and MCA.

In this roundup, 19 systems used caching disk controllers, which improved their performance on our disk test. By far the two fastest disk scores were logged by the Clover 486 EM II (2,357 KBps) and the Tangent Model 450ex (2,209 KBps). Each used a 32-bit EISA Mylex DEE376 controller with a 4MB cache, combined with a SCSI hard disk—a 15-ms 213MB Maxtor LXT21354 for the Clover and a 14-ms 210MB Western Digital WDSP4200 for the Tangent. The third-fastest system was the

FutureTech System 452E, which also featured an EISA-based 4MB cache controller—the AMI FTS-FD—in conjunction with a 12-ms 340MB Fujitsu M2622FA SCSI hard disk.

These three systems clearly outpaced the others because their 4MB caches are large enough to contain the entire variable-file-size disk test suite from PC Magazine Labs' Hardware Performance Tests, Release 6.0. Our variable-file-size tests never even got to these systems' hard disks.

VIDEO

The Compaq Deskpro 50M, with its proprietary QVision design running on the EISA bus, was the clear performance winner under Microsoft Windows. Three systems featuring the ATI Graphics Ultra were the next-fastest performers, but a wide margin separated them from the Compaq. The remaining results of our DOS-based video and Graphics Winmark tests reflect a trend that we've seen before: Video designs centered around the S3 P86C911 chip are tuned for better Windows graphics performance than conventional DOS video. The opposite is true for systems using the Tseng ET4000 chip. Nearly half the systems we tested—31 to be exact—used an S3 chip-based accelerated video design, while 14 featured the Tseng ET4000.

On the Graphics Winmark test, the Compaq turned in a spectacular score of 19.16 million, the best seen by PC Magazine Labs since we started reporting Windows graphics performance. Second, third, and fourth places for Winmark performance go to three systems based on the ATI Graphics Ultra: the Standard Advantage 486 DX2/50, the AcerPower 486DX2/50 WU, and the ACMA 486DX2/50. All three achieved Winmark scores in excess of 9 million. The next 13 consecutive rungs on the graphics performance ladder were captured by machines

based on the S3 chip, with scores ranging from 8.79 million for the Micro Generation MG50DX2 (which used a G-Hosts3 Plus card) to 7.25 million for the Tangent Model 450ex (which used a Diamond Stealth VRAM card). All of these were clearly above the average Winmark score of 5.23 million.

Two designs worthy of mention featured proprietary local-bus designs centered around the S3 chip. The Swan 486DX2-50DB placed ninth with its score of 7.88 million, and the Ares 486-50DX2 Sonic III made the top ten with its score of 7.87 million. More advanced drivers should help these systems squeeze greater performance from their advanced hardware designs. Since testing occurred shortly after Version 3.1 of Microsoft Windows was released, many of the systems did not meet our expectations, because of video drivers that were not fully optimized for the new version.

For conventional DOS video performance, the fastest system used a local-bus design and featured the Tseng ET4000 chip set: the NEC PowerMate 486/50i. Its 7,661 thousand video operations per second was roughly three times as fast as the average of 2,587 thousand operations per second. The Tseng ET4000-based systems generally performed well on our DOS-based video test. The Compaq turned in a strong second-place score and showed itself to be by far the best all-round video performer. Two systems, the AST Power Premium 4/50d and the Austin 486 WinStation DX2-50 used the Western Digital WD90C31 chip, which allowed each to turn in a top-ten score on our video test and very respectable Winmark scores of 6.66 and 7.23 million, respectively. This chip set has consistently generated balanced DOS-based and Windows graphics results during previous tests, and is a good general-purpose video chip set.

CONTINUES

Benchmark Tests: 50-MHz 486 DX2s

CONTINUES

After a close look at 63 systems based on Intel's new speed-doubler 50-MHz 486 DX2, the evidence is clear. Systems featuring a well-designed secondary processor RAM cache will perform nearly as well as a true 50-MHz 486, for hundreds of dollars less.

HOW WE TESTED

We used PC Magazine Labs' Hardware Performance Tests, Release 6.0, to measure the PC's processor, memory, disk, and video subsystem performance. Each test measures the number of operations performed or the data throughput over a period of time. We also used WINBENCH 2.5 to obtain the Graphics Winmark scores. To view the data we used to create this chart, look for GEOMEA.WK1 and GEOMEA.XLS in Library 3 of PC MagNet's Utility Forum. In all cases, a larger number means better performance.

We performed all the tests with the RAM and video cache shadowing enabled whenever possible. We report the disk performance without software disk caches.

The **processor** test measures different aspects of the CPU's performance and its interaction with cache and main memory. The test consists of eight routines: an Instruction Mix native to the microprocessor type (386 or 486, for instance) and 128K No-Operation, Do-Nothing, Integer-Add, Integer-Multiply, Floating-Point Mix, String-Sort and -Move, and Prime-Number Sieve routines.

The **memory** benchmark test measures the read/write performance of the computer's first 640K of conventional memory

The **disk** benchmark test evaluates the mechanical drive speed, hard disk controller functions, and bus speed, using a series of small-record (512-byte and 4K) exercises followed by similar large-record (16K and 32K) exercises. Both small- and large-record exercises include file-create, sequential write/read, and random write/read operations.

The **video** benchmark test consists of text and graphics routines. In the Direct Screen Write routine, the video adapter's screen memory writes text to the screen. The test then performs several graphics operations, including screen fills and bit-block transfers (BitBlts).

With the release of Version 2.5 of PC Labs' WINBENCH tests (our graphics performance tests for Microsoft Windows), PC Labs has introduced a new method of measuring graphics performance. The **Graphics Winmark** is the geometric mean of 12 WINBENCH graphics tests, measured in millions of pixels per second. PC Labs profiled the major Windows applications in November 1991 and determined which graphics functions are most frequently used within Windows. The Winmark takes into account 12 tests of these key functions and weights them to reflect how frequently the functions are used. Windows applications also use other graphics functions, but far less often.

PROCESSOR

Operations per second	0	200	400	
AcerPower 486DX2 50 VxD				526
ACMA 486DX2 50				490
Artes 486DX2 and Bus				490
Amax 486DX2 Power Station				490
Amity 486DX2 50E				489
Archer Equinox 486 50DX2				525
Arm 486DX2 50E				522
Arm 486DX2 50				524
AST Power Premium 4 50c				482
ATronics ATI-486/50DX2				583
Austin 486 WinStation DX2-50				582
Axix Ace Cache 486DX2-50				522
C2 Saber DX2				441
Clever 486 EM				516
Clut Equinox 450 DX2				522
Compaq Express 50M				524
Compaq Executive 486 50				471
Computer Sales Professional Pro 486DX2 50				511
Comstar 486 eISA WinStation				512
CSS Professional 4.5 486				467
Datavision 486 486DX2 50				378
Devec Production 486DX2 50				525
De System 486DX 50				498
Diamond DT 486DX2 50				513
Digital DECpc 486ST				486
Edge 486 DX2-50				472
Eltech Model 4500 DX2				525
EPS 486-50DX EISA				482
Epson Equinox 486DX2 50 Plus				540
Evmax STE 486DX2 50E				518
Future-Tern System 452E				515
GRC MPE 486				424
Hent 486 50X2e				581
Hx 486				514
IBM PS/2 Model 95 XP 486 25 50				487
Inter Byte Max Mainstr 486 50c				503
Kepco 486DX2 50 EISA slot				484
Leadtek 486 486DX2 50				398
Matrix 486DX2				523
Max 486 486DX2 50E				582
Micro Express ME 486-50 DX2				523
Micro Generation 1 MG50DX2				377
National Micro System Flash 486DX2-50				584
NCR system 3335				485
NE PowerMate 486 50				498
NET 486 486DX2				515
Northern 486				444
Novell premium 486 DX2 50				508
Oncom 486				471
PC Brand 486 50 EISA Tower				485
Pro 486 486DX2				527
Star AST 486DX2 50MVC				488
Seamless City MD				582
Sprint 486 486DX2				351
Star 486 486DX2 50				582
Star 486DX2 50E				521
Tangent Model 450c				525
Tro 486 486DX2 EISA				515
Umax PW2 486 AT tower				422
United Micro M 486 486DX2				518
USA Box 486DX2 50 system				583
Wyse 486 486DX2				487
Zeus 486DX2 50				428

WORST

BEST

Can You Spot The Winner?



Gateway 2000 The Winners Circle

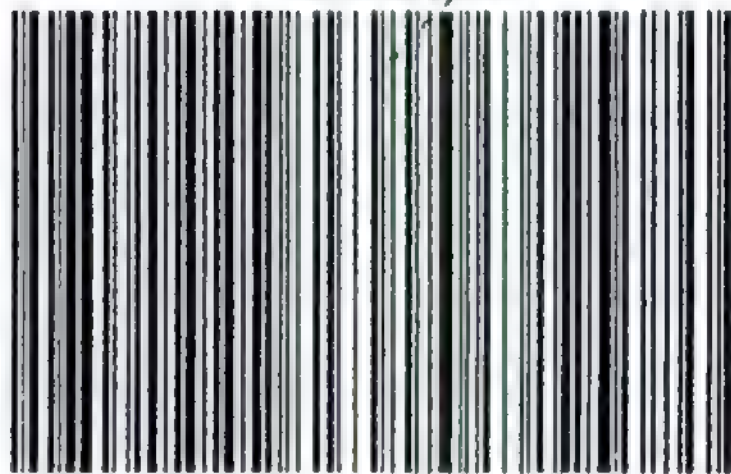


Gateway 2000 employees were photographed for the summer fun ad at Atokad Park in South Sioux City, Nebraska.

1. Follow instructions on the other side

Back

Gbs5lipBack-001B

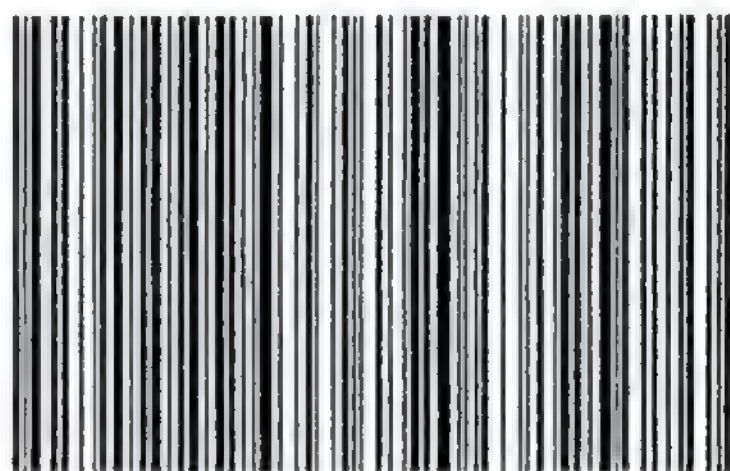
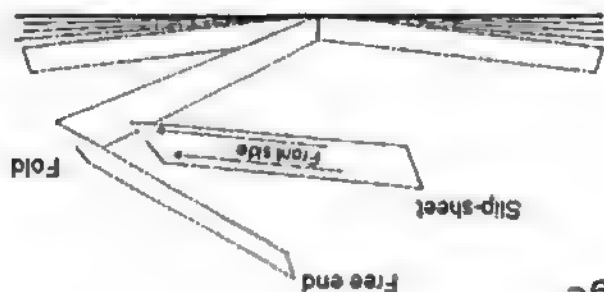


Inverted Back

1. Follow instructions on the other side

Foldout slip-sheet

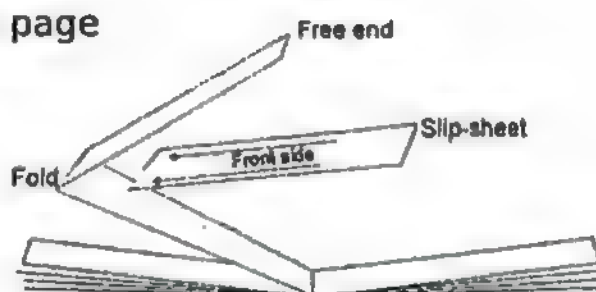
1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



GbsSlipSheet-001

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Folded edge of the page

It's Gate That Puts You In 1



The Choice Is Black & White!



The results are final — all those thoroughbred "favorites" outdistanced by a simple, determined, black-and-white cow! And once again, Gateway 2000 leads the pack to bring you new technology at down-on-the-farm prices.

We've incorporated Intel's new 66MHz DX2 clock-doubler chip, the fastest processor available today, in a reliable ISA machine with racing video and disk performance!



It's just one more big winner in our lineup of value-packed, high-performance systems. So give us a call and get in the Gateway 2000 Winner's Circle!



CASHIER



HERE'S A HOT TIP: GATEWAY 2000 IS A SURE THING!

Before you put your money down, study the statistics on the contenders. The current trend in the PC industry is to cut prices by stripping down systems and replacing quality components with inferior parts. Even companies with long-standing traditions of quality are doing it. At Gateway, we've never lowered our prices in response to market pressures. We've never needed to. And we'll never sacrifice features or quality to make prices look better. Our race strategy has always been to offer the best price, quality and service in the market.

Price

Gateway's price advantage is simple business economics. We have huge volume buying power. The little guys don't. We have low overhead. You don't pay for glass palaces with us. And we operate on conservative margins. While we've grown big and strong on these rations, our margins are a starvation diet for some of our competitors. We lower prices whenever we can. And we've been quietly doing this since day one.

Quality

When surveyed recently by *PC Magazine*, Gateway customers gave their systems the **highest reliability rating** among 35 of the nation's top PC manufacturers. That's certainly an indication that our great prices aren't a trade-off for quality or performance. Gateway systems are loaded with top-of-the-line components and performance features. We know you don't want a cheap computer. You want a great computer at a great price. You want a Gateway!

Service

We know how important service is to you. That's why we're constantly working to provide the best in the business. Service is one of the reasons we received the **highest customer satisfaction rating** in *PC Magazine's* service survey. Gateway scored "significantly better than any other manufacturer" when PC users were asked, "Would you buy again from the same manufacturer?"

Price. Quality. Service. This simple formula still equals the best value in the industry. Add Gateway's ability to bring you the latest technology at the best prices, and you have a triple-crown winner. So put your money on a sure thing. With Gateway 2000, you're guaranteed to come out a winner!



VALUE



GAIN THE WINNING EDGE WITH 486 PERFORMANCE

Gateway's powerful 486 models give you the winning margin! And when you recap our new price reductions and compare us feature-for-feature against other runners, you'll find you won't even have to play your hunches — Gateway 2000 is the odds-on favorite.

25MHz 486SX

■ \$1895

This is the hottest value on the market! You get 486 technology, including an 8K internal cache and burst mode, at a 386 price. And besides being faster than any 386 on the market, the 486SX/25 is upgradeable to 50MHz if you need increased performance in the future.

33MHz 486DX

■ \$2395

We recently increased performance and lowered the price of our best-selling, award-winning 486DX/33 by adding an ATI™ Graphics Ultra video card and a faster, 200MB Western Digital hard drive with 13ms access time. At \$2,395, the price/performance ratio on this machine is hard to beat. Plus, you can upgrade this system to 66MHz.



50MHz 486DX2

■ \$2695

Gateway 2000's new 486DX2/50 systems, ISA and EISA, incorporate Intel's speed-doubler technology. The internal core of the DX2 processor executes at 50MHz while communicating with the external memory bus at 25MHz. Our benchmarks show a 35% increase in performance over a 33MHz 486DX.

This system also has the new, faster Western Digital 200MB hard drive and the high-performance ATI Graphics Ultra video card.

50MHz 486DX2 EISA

■ \$3695

Our EISA system comes standard in a floor-standing tower model, and includes a large, fast SCSI drive and an EISA SCSI controller as standard equipment. RAM cache is expandable to 256K.

66MH 486DX2

■ Call for details.

Gateway 2000 systems come fully configured with all the performance features you want, including two floppy drives, a programmable 124-key AnyKey™ keyboard, a Microsoft® mouse, MS-DOS® 5.0, Windows™ 3.1 and your choice of one application software option. See the back pages of this ad for complete configurations and information about software options, upgrades and peripherals.

486 SYSTEMS

 **GATEWAY2000**



GATEWAY 2000 NOTEBOOKS PUT YOU IN RACING FORM

The Nomad Series

Our small, lightweight Nomad notebook computers let you take desktop computer performance anywhere you go. Nomad models come with VGA graphics, a FieldMouse™ (portable pointing device), built-in floppy drive, and an 80 or 120MB hard drive, depending on the model. A patented power-management system gives you hard-to-beat battery life benchmarks — over six hours of operation from a single battery on the 25MHz 486DX system!

The Nomads have a bright, crisp, backlit, 10-inch triple supertwist VGA screen — resolution is 640 x 480, 64 gray scale, on the LCD. With simultaneous video, you can also display on an external monitor.

All these features ... and the Nomads are made in the U.S.A.!

Nomad 325SXL ■ \$1995

25MHz, 386SXL processor

■ 4MB RAM ■ 80MB hard drive

Nomad 420SXL ■ \$2695

20MHz, Intel® 486SXLP processor

■ 4MB RAM ■ 80MB hard drive

Nomad 425DXL ■ \$3495

25MHz, Intel 486DXLP processor

■ 4MB RAM ■ 120MB hard drive



For The Power User On The Go

Nomad Combo ■ \$3995

Since the Nomad 425DXL has all the power of a 486DX desktop system, it's the ideal portable/desktop combination system! Save with this combo package!

Combo Highlights: Nomad 425DXL ■ 15" CrystalScan 1572FS color monitor

■ programmable 124-key AnyKey™ keyboard

The HandBook™

If you like to travel light, you can't go wrong with the HandBook. It weighs only 2.75 pounds and measures roughly 6 x 9 inches — smaller than this magazine! Yet it has 286-class performance and real PC features including a bright, backlit screen, a bonafide 40MB hard drive and a comfortable keyboard (no chiclet keys). Downloading information from your HandBook to your office computer is easy with the serial cable and file transfer software provided.

HandBook ■ \$1295

For The Executive On The Go

HandBook Combo ■ \$3995

Combine the portability of our HandBook with the power of our 33MHz 486 desktop system with communication capabilities — and you have a terrific combo, Gateway value-priced!

Combo Highlights: HandBook with 2,400 bps external modem and communication software

■ 33MHz 486DX system with 120MB IDE hard drive ■ TelePath™ fax/modem package

PORTABLES



"You've got a friend in the business."

GATEWAY 2000 ADDS A FREE SOFTWARE BONUS

Choose Your Free Software Option

With the purchase of any Gateway 2000 mini desktop, desktop or tower computer system, you receive your choice of one application software option at no additional cost. We'll install your software on your hard drive, optimally configured for your system and Windows, and provide master diskettes and manuals. You may also purchase a second application software option, pre-installed, at extremely competitive prices.

Installation and setup errors are responsible for over one-third of all software problems. You can eliminate that possible source of problems by purchasing your system from Gateway with software pre-installed, tested, and ready to run the moment your system arrives. Add that advantage to the hard-to-beat prices, and Gateway is the only logical choice for PCs and software!

Choose one of the following application software options:

Option #1-Microsoft Excel for Windows™ 4.0

■ New version of this powerful spreadsheet, includes online help for Lotus 1-2-3® users



Option #2-Microsoft Word for Windows™ 2.0

■ Best-selling word processor for Windows. New version 2.0 adds online help for WordPerfect® users



Option #3-Microsoft PowerPoint for Windows™ 3.0

■ Easy-to-use desktop presentations program creates high-quality overheads and 35mm slides



Option #4-Borland® Paradox® 4.0

■ The award-winning database from Borland



Option #5-The Entrepreneur Pack

■ Includes the latest Windows versions of Microsoft Works™, integrating word processing, spreadsheet, and database in one easy-to-use program; Microsoft Publisher™ for creating page layouts; Microsoft Money™ to help you write checks, set budgets, track expenses; PLUS an Entertainment Pack with eight games, including Tetris®



Option #6- The Windows Programmer Pack

■ Includes everything you need to create programs for Windows: *Microsoft QuickC for Windows™*, *Windows Control Development Kit™*, *Windows Help Compiler™* and *Windows Programmers' Online Reference™*.



Option #7-Microsoft Project for Windows™ 3.0

■ Flexible and easy project management program

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More Software At A Great Price!

The following applications are only available with the purchase of a system, pre-installed, or to Gateway customers.

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Central Point Backup™ 7.2 for Windows ■ \$75

The Norton Desktop™ 2.0 and Prisma Your Way 2.0 For Windows ■ \$95

These offers include the identical applications contained in retail packages but will not include the retail box. You get all master diskettes and manuals, shrink-wrapped and packaged in a Gateway 2000 box.

Peripherals

The 15-Inch CrystalScan 1572FS

You'll enjoy your new Gateway 2000 computer even more if you choose the new 15-inch CrystalScan color monitor option. The CrystalScan 1572FS has a flat, square, non-glare screen to reduce distortion around the corners and provide edge-to-edge display area.

The CrystalScan 1572FS is an upgrade option only with the purchase of a 386DX or 486 system for an additional \$195.



The Gateway 2000 TelePath™ Fax/Modem

The Gateway 2000 TelePath is a 14,400 bps mode, V.32bis, with 9,600 bps fax capability. The TelePath comes with WinFax Pro™, Crosstalk™ for Windows, Qmodem™ and a free 30-day basic services CompuServe® membership — all for only \$195!

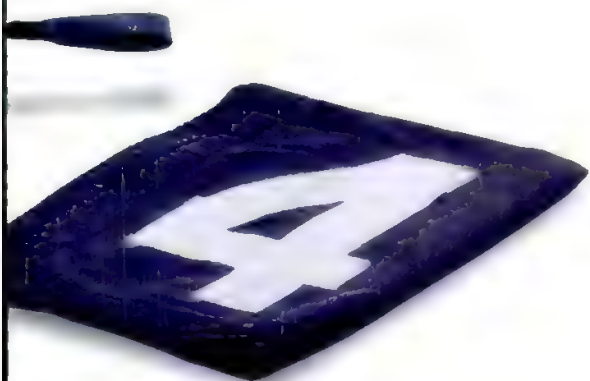
■ Fax mode: V.17, V.29 and V.27ter

■ Data mode: V.32bis, V.32, V.22bis, V.22, V.21, Bell 212A and 103, V.42 and MNP 2-4 error correction, V.42 bis/MNP 5 data compression

Included With Every System:

■ One-year limited warranty ■ 30-day money-back guarantee ■ Lifetime toll-free technical support ■ Free on-site service to most locations (*factory service only for notebooks*) ■ Free bulletin board technical support ■ C.O.D. terms and major credit cards honored ■ Net 30-day credit terms and leasing options available to qualified commercial customers

*Sorry — we sell peripherals only with the purchase of a Gateway 2000 system, or to people who are already Gateway 2000 customers. For fastest service, call our new direct line for the **Component Add-On Division: 800-252-3333**. Please have your customer ID handy when you call.*



GATEWAY 2000 WINNERS CIRCLE

PORTABLES

HANDBOOK

- 286 Class Performance
- 1MB RAM upgradeable to 3MB
- 40MB Hard Drive
- Backlit 7.6" CGA Screen
- Size 5.9" x 9.75" x 1.4", 2.75 Lbs.
- 4.5-Hr.* NiMH Battery & AC Pack
- 1 Parallel/1 Serial Port
- 78-Key Keyboard
- MS DOS 5.0, File Transfer Software & Serial Download Cable
- Introductory Bonus Pack
- Carrying Case

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NOMAD 325SXL

- 25MHz, 386SXL Processor
- 4MB RAM
- 1.44MB 3.5" Drive
- 80MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 256K
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 7-Hr.* NiCad Battery & AC Pack
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse™ Pointing Device
- MS DOS® 5.0 and Windows™ 3.1

\$1995

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- 4MB RAM
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- 80MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 6-Hr.* NiCad Battery & AC Pack
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse Pointing Device
- MS DOS 5.0 and Windows 3.1

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- 25MHz, Intel 486DXLP Processor
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- 1.44MB 3.5" Drive
- 120MB IDE Hard Drive
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- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 6-Hr.* NiCad Battery & AC Pack
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse Pointing Device
- MS DOS 5.0 and Windows 3.1

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DESKTOPS

25MHz 386SX

- Intel 386SX Processor
- 4MB RAM
- 1.2MB & 1.44MB Drives
- 80MB 17ms IDE Cache Drive
- 16-Bit SVGA with 512K
- 14" CrystalScan 1024 Color VGA Monitor
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- 124-Key AnyKey™ Keyboard
- Microsoft® Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

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- 4MB RAM
- 1.2MB & 1.44MB Drives
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- 14" CrystalScan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

\$1895

33MHz 486DX

- Intel 486DX Processor
- 64K Cache RAM
- 4MB RAM
- 1.2MB & 1.44MB Drives
- 200MB 13ms IDE** Cache Drive
- ATI Graphics Ultra Video
- 14" CrystalScan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

\$2395



50MHz 486DX2

- Intel 486DX2 Processor
- 64K Cache RAM
- 8MB RAM
- 1.2MB & 1.44MB Drives
- 200MB 13ms IDE** Cache Drive
- ATI Graphics Ultra Video
- 14" CrystalScan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software

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****Enhanced IDE with RIDE (Rapid Integrated Drive Electronics)**

50MHz 486DX2 EISA

- Intel 486DX2 Processor
- 128K Cache RAM
- 8MB RAM
- 1.2MB & 1.44MB Drives
- 340MB 15ms SCSI Cache Drive
- 32-Bit EISA SCSI Controller
- 16-Bit SVGA with 1MB
- 14" CrystalScan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0 and Windows 3.1
- Choice of Application Software
- Tower Model is Standard

\$3695

66MHz 486DX2

- Call for details

* Battery life was measured using PC Magazine's Battery Run Down Test with power management enabled. Actual results may vary depending on configuration and applications.

All prices and configurations are subject to change without notice. Prices do not include shipping. Components, peripherals and software are sold only with the purchase of a system, or to customers who already own Gateway 2000 systems. Some limitations apply.



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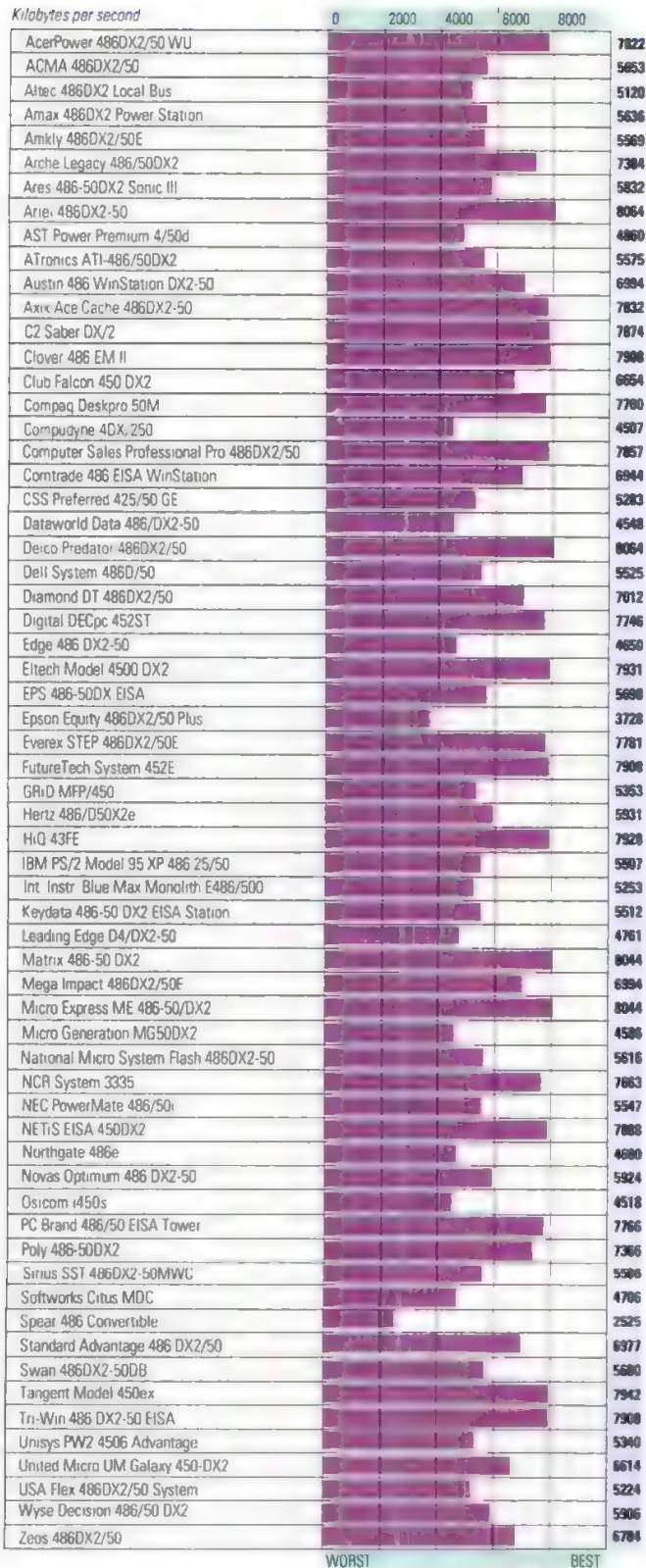
Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CDT)

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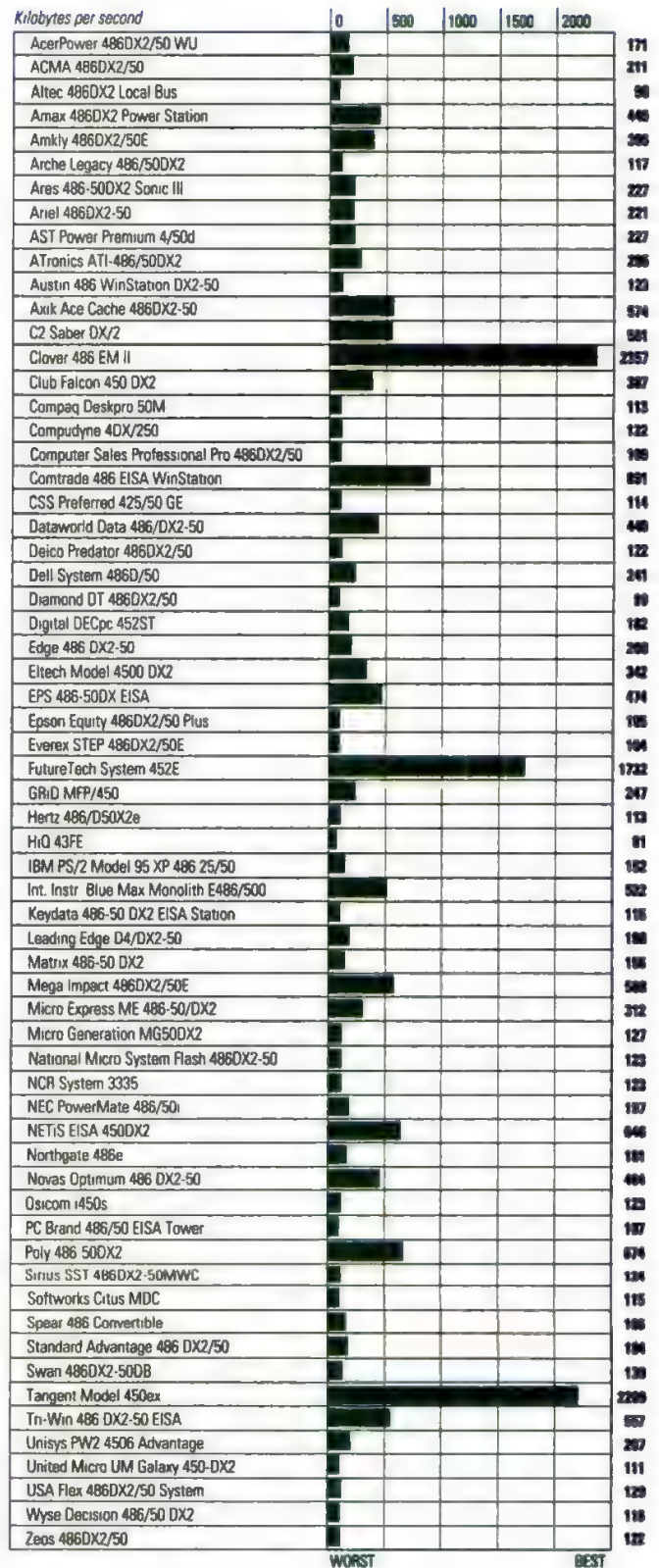
Benchmark Tests: 50-MHz 486 DX2s

CONTINUES

MEMORY



DISK





OS/2

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It's not about
fixing old windows.

It's about
opening new doors.

OS/2® 2.0 is more than a new version. It's a new vision. A true operating system that takes your DOS, Windows™ and OS/2 applications beyond the limitations of the past—lets you do more with them than you ever could with DOS or DOS with Windows.

Unlike Windows, OS/2 2.0 can run multiple DOS, Windows and OS/2 applications at the same time, in separate windows on the same screen. Print a document and calculate a spreadsheet while you create a new letter. Use icons to print documents without even opening the program. You can even “cut and paste” between *any* applications—the possibilities are endless. And with OS/2 Crash Protection™, each running application is protected from the next, so if one goes down it won't affect the others.

Of course, there's a graphical interface that makes OS/2 easy to install, learn and use—the Workplace Shell™. But maybe the best part is that for less than the cost of DOS and Windows, you get the capabilities of both. Plus all the added benefits of OS/2 2.0—including Adobe Type Manager™. So for a whole lot less, OS/2 2.0 gives you a whole lot more.

For an IBM authorized dealer near you, or to order OS/2 2.0 from IBM, call 1 800 3-IBM-OS2*.



Introducing OS/2 2.0.

- *Runs DOS, Windows and OS/2 applications from a single system.*
- *OS/2 Crash Protection helps shield applications from each other.*
- *Now pre-installed on PS/2® Models 56 and 57.*
- *Supported on most IBM-compatible 386 SX PCs and above.*
- *To order OS/2 2.0, call 1 800 3-IBM-OS2.*

Benchmark Tests: 50-MHz 486 DX2s

ENDS

VIDEO

Thousands of operations per second

	0	2000	4000	6000	
AcerPower 486DX2 50 WU					2609
ACMA 486DX2/50					3050
Altec 486DX2 Local Bus					2194
Amax 486DX2 Power Station					1981
Amkly 486DX2 50E					1217
Arche Legacy 486/50DX2					3500
Ares 486-50DX2 Sonic III					1732
Ariel 486DX2-50					4933
AST Power Premium 4/50d					4900
ATronics ATI-486/50DX2					1482
Austin 486 WinStation DX2-50					4670
Axix Ace Cache 486DX2-50					1519
C2 Saber DX/2					1981
Clover 486 EM II					1473
Club Falcon 450 DX2					2958
Compaq Deskpro 50M					5900
Compudyne 4DX/250					2015
Computer Sales Professional Pro 486DX2/50					1639
Comtrade 486 EISA WinStation					1762
CSS Preferred 425/50 GE					1627
Dataworld Data 486/DX2-50					1337
Deico Predator 486DX2/50					3840
Deil System 486D/50					4272
Diamond DT 486DX2/50					2811
Digital DECpc 452ST					3381
Edge 486 DX2-50					1785
Elitech Model 4500 DX2					3910
EPS 486-50DX EISA					4470
Epson Equity 486DX2/50 Plus					2675
Everex STEP 486DX2/50E					1646
FutureTech System 452E					1976
GRiD MFP/450					4880
Hertz 486/D50X2e					1527
HiQ 43FE					1985
IBM PS/2 Model 95 XP 486 25/50					3202
Int. Instr. Blue Max Monolith E486/500					1784
Keydata 486-50 DX2 EISA Station					1201
Leading Edge D4/DX2-50					2721
Matrix 486-50 DX2					3887
Mega Impact 486DX2/50E					1388
Micro Express ME 486-50/DX2					1626
Micro Generation MG50DX2					1585
National Micro System Flash 486DX2-50					1254
NCR System 3335					3346
NEC PowerMate 486/50i					7661
NET/S EISA 450DX2					1429
Northgate 486e					1267
Novas Optimum 486 DX2-50					1027
Osicom i450s					1588
PC Brand 486/50 EISA Tower					2520
Poly 486-50DX2					1435
Sirius SST 486DX2-50MWC					1412
Softworks Citrus MDC					3548
Spear 486 Convertible					1199
Standard Advantage 486 DX2/50					2871
Swan 486DX2 50DB					2054
Tangent Model 450ex					1918
Tri-Win 486 DX2-50 EISA					1984
Unisys PW2 4506 Advantage					3634
United Micro UM Galaxy 450-DX2					3957
USA Flex 486DX2/50 System					1901
Wyse Decision 486/50 DX2					3145
Zeos 486DX2/50					1882
	WORST			BEST	

GRAPHICS WINMARK

Megapixels per second

	0	4	8	12	16	
AcerPower 486DX2/50 WU						9.19
ACMA 486DX2 50						9.19
Altec 486DX2 Local Bus						8.46
Amax 486DX2 Power Station						7.14
Amkly 486DX2/50E						0.95
Arche Legacy 486/50DX2						2.57
Ares 486-50DX2 Sonic III						7.87
Ariel 486DX2-50						3.31
AST Power Premium 4/50d						6.66
ATronics ATI-486/50DX2						0.84
Austin 486 WinStation DX2 50						7.23
Axix Ace Cache 486DX2-50						7.12
C2 Saber DX/2						8.86
Clover 486 EM II						6.17
Club Falcon 450 DX2						2.44
Compaq Deskpro 50M						19.16
Compudyne 4DX/250						5.99
Computer Sales Professional Pro 486DX2/50						1.13
Comtrade 486 EISA WinStation						6.96
CSS Preferred 425/50 GE						7.55
Dataworld Data 486/DX2-50						5.95
Deico Predator 486DX2/50						3.41
Deil System 486D 50						1.58
Diamond DT 486DX2/50						1.88
Digital DECpc 452ST						2.14
Edge 486 DX2-50						6.97
Elitech Model 4500 DX2						2.10
EPS 486-50DX EISA						2.60
Epson Equity 486DX2/50 Plus						N/A
Everex STEP 486DX2/50E						1.14
FutureTech System 452E						7.56
GRiD MFP/450						2.41
Hertz 486/D50X2e						6.78
HiQ 43FE						6.04
IBM PS/2 Model 95 XP 486 25/50						3.94
Int. Instr. Blue Max Monolith E486/500						7.33
Keydata 486-50 DX2 EISA Station						6.85
Leading Edge D4/DX2-50						1.14
Matrix 486-50 DX2						2.24
Mega Impact 486DX2/50E						6.54
Micro Express ME 486-50/DX2						6.87
Micro Generation MG50DX2						8.79
National Micro System Flash 486DX2-50						6.99
NCR System 3335						3.42
NEC PowerMate 486/50i						3.86
NET/S EISA 450DX2						6.82
Northgate 486e						6.67
Novas Optimum 486 DX2-50						5.27
Osicom i450s						1.12
PC Brand 486/50 EISA Tower						1.50
Poly 486-50DX2						6.22
Sirius SST 486DX2-50MWC						6.79
Softworks Citrus MDC						2.24
Spear 486 Convertible						4.12
Standard Advantage 486 DX2/50						9.71
Swan 486DX2-50DB						7.86
Tangent Model 450ex						7.25
Tri-Win 486 DX2 50 EISA						7.73
Unisys PW2 4506 Advantage						0.42
United Micro UM Galaxy 450 DX2						2.53
USA Flex 486DX2/50 System						7.30
Wyse Decision 486/50 DX2						1.47
Zeos 486DX2/50						7.31
	WORST				BEST	

N/A—Not applicable. The Epson Equity 486DX2/50 Plus did not have the proper drivers to run our Graphics Winmark test at 800-by-600 resolution with 256 simultaneous colors.

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One-Write Plus 3.0	Yes	Yes	Yes	Yes
QuickBooks™ 1.0	No	No	No	No

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ports run off the system board, too.

Dig any deeper than this, though, and the Amkly's makeup will smudge radically. The motherboard, for all its positives, is missing one crucial feature: a secondary RAM cache. Because of this, processor and memory scores were bottom-rung for this machine, and video scores (based on the vanilla-flavored Trident chip set) verged on ugly. The UltraStor caching disk controller provided the Amkly's only good score.

Amkly offers a one-year parts-and-labor warranty and free on-site service through Texas Instruments. Technical support is available via a toll-free line.—OR

Arche Technologies Inc.

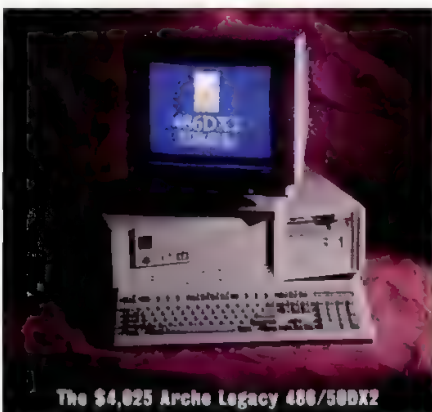
Arche Legacy 486/50DX2

Though parts of Arche Technologies' \$4,025 EISA-bus Arche Legacy 486/50DX2 shine, the system as a whole has too many idiosyncrasies to justify its price.

Our test unit had an AMI BIOS, 4MB of RAM (with an unfortunate 8MB maximum), and 256K of 20-nanosecond direct-mapped write-back RAM cache. An UltraStor 24F EISA SCSI hard disk controller drove the 23-millisecond Maxtor LXT213SY 212MB SCSI hard disk; a single TEAC 3.5-inch floppy disk drive ran off the system board. Video was based on a 16-bit ISA Diamond SpeedSTAR video card carrying the Tseng ET4000 chip set and 1MB of video RAM. The card was paired with a 14-inch Arche monitor that had a 70-Hz refresh rate at 1,024-by-768 resolution.

The Arche arrived in a fairly solid full-size desktop case. All five of its drive bays were 5.25-inch half-heights (three front-accessible and two internal). Motherboard expansion consists of eight EISA slots, six of which were empty in our test system.

Though the case is sturdy, an internal screw mounting that points downward drags across and catches on all the inter-



The \$4,025 Arche Legacy 486/50DX2

FACT FILE

Arche Legacy 486/50DX2
Arche Technologies Inc., 48881 Kato Rd.,
Fremont, CA 94539; 800-437-1688,
510-623-8100; fax, 510-683-6754

List Price (Tested Configuration): \$4,025
Memory and processor RAM cache: 4MB 80-ns
SIMMs, 256K cache
Disk drives and controller: Maxtor 23-ms. 212MB
SCSI hard disk, UltraStor 24F controller, 1.2MB and
1.44MB floppy disk drives
Display: Diamond 1,024-by-768 adapter with 1MB
RAM, Arche 14-inch monitor, 70-Hz refresh rate
Software: DOS 5.0, Microsoft Windows 3.1, WinRix
In Short: The Arche Legacy 486/50DX2 is an average
package marred by a few idiosyncratic features and a
higher-than-average price tag

 ON READER SERVICE CARD

nal cables—sometimes hard enough to disconnect them. Our test unit, which came with Microsoft Windows 3.0 drivers, had some difficulty running Version 3.1, but proper Windows drivers resolved that problem. The analog image-sizing controls on the monitor

were disappointing, though at least all the controls were front-mounted. The rest of the system was satisfactory, with a decent keyboard, complete but somewhat technical system documentation, DOS 5.0, Microsoft Windows 3.1, Diamond

SpeedSTAR's WinRix software, and the UltraStor driver.

Performance results were erratic. The OPTi-controlled RAM cache resulted in a processor score among the top five and a very respectable memory score. The

video adapter, geared to DOS, turned in a good score on our DOS-based video test, but as with other systems, it was slower under Windows.

The company sells the Arche Legacy 486/50DX2 with a two-year parts-and-labor warranty that includes free on-site service from ISC Bunker-Ramo. Technical support usually starts with a call to your dealer or distributor; Arche has a technical support line, but it is not toll-free. Users may send units either to their dealer or to Arche for repair.—OR

Ares Microdevelopment Inc.

Ares 486-50DX2 Sonic III

The \$3,195 Ares 486-50DX2 Sonic III ISA desktop system comes standard with 4MB of 60-nanosecond RAM and a 240MB hard disk. With quality workmanship, certified components, and better-



The \$3,195 Ares 486-50DX2 Sonic III

than-average service and support, the Ares is a very good buy.

The Technology Power Sonic III motherboard, custom-built for Ares Microdevelopment, has a VLSI chip set and an AMI BIOS. The 128K of 20-nanosecond direct-mapped write-back cache is expandable to 512K. Managed by a Northport Technology 82C480 cache controller, it helped the unit score eleventh out of 63 machines on our processor test. On disk performance, the 16-millisecond 240MB Quantum ProDrive LPS hard disk with a 256K cache placed twenty-third.

Ares has developed its product line as a response to four specific uses: Windows, desktop publishing, CAD, and multimedia. Our test system, geared to Windows, had a video subsystem based on a Technology Power Sonic Spectrum board with

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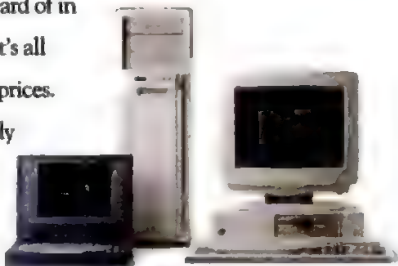
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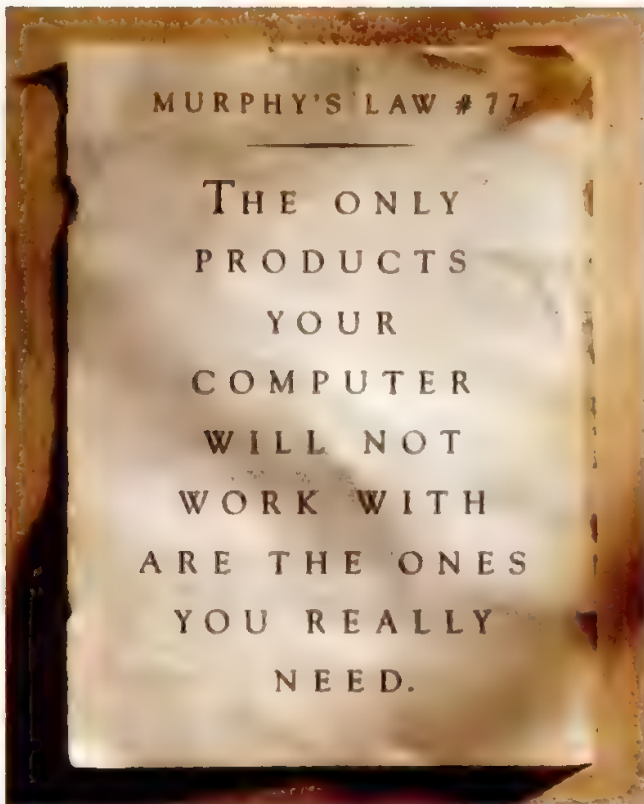
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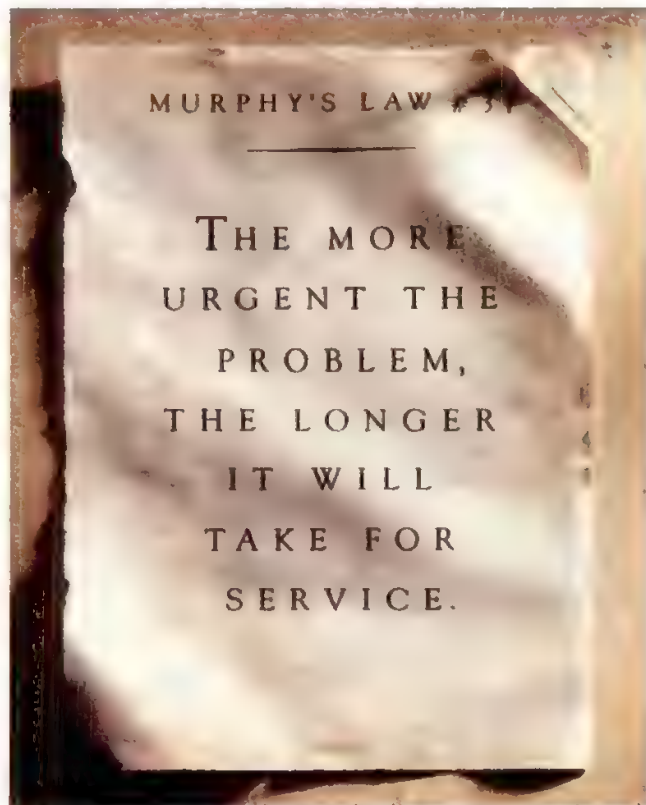
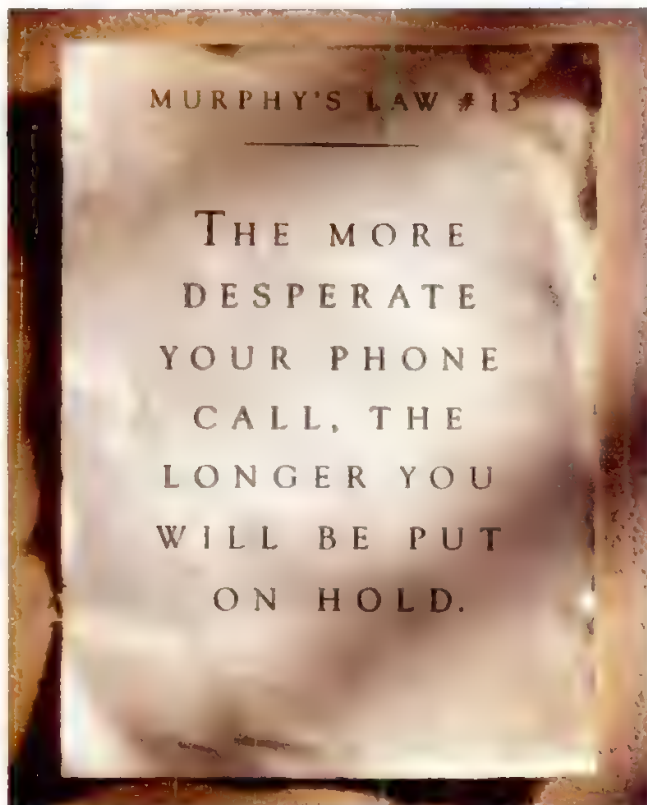
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FACT FILE

Ares 486-50DX2 Sonic III

Ares Microdevelopment Inc., 23660-A
Research Dr., Farmington Hills, MI 48335;
800-322-3200, 313-473-0808;
fax, 313-473-4450

List Price (Tested Configuration): \$3,195

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 128K cache

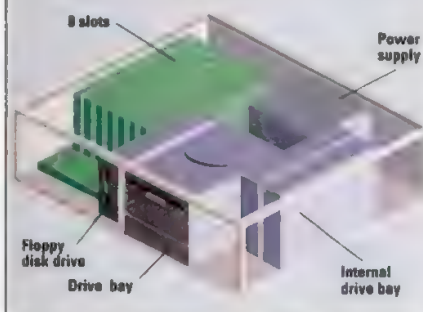
Disk drives and controller: Quantum 16-ms, 240MB
IDE hard disk, 256K cache, 1.2MB and 1 44MB floppy disk
drives

Display: Ares 1,024-by-768 adapter with 1MB RAM,
ViewSonic 14-inch monitor, 72-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1, Microsoft
Money, Microsoft Publisher, Microsoft Works, QA Plus

In Short: The Ares 486-50DX2 Sonic III is a reasonable
buy with better-than-average performance, room for ex-
pansion, and quality support.

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an S3 86C911 graphics accelerator and 1MB of video RAM. Its performance took tenth place on our Graphics Winmark test; however, like other S3 chip-accelerated boards, it yielded a low score on our DOS-based video test. Users can order a Diamond Stealth or a Diamond SpeedSTAR Plus board instead. Our monitor was a 14-inch ViewSonic SE with a 72-Hz refresh rate at 1,024-by-768 resolution.

Inside, Ares aims for perfection: Components are firmly secured, cables are neatly folded, and wires are braided to improve airflow. The case is designed to accommodate as much expansion as possible within the desktop form factor. SIMM sockets on the motherboard hold the 64MB RAM maximum. The eight slots consist of six 16-bit ISA and two 32-bit proprietary. One holds a processor module card; the other, local-bus video. In our test system, four 16-bit slots were empty. With its six drive bays, a fully

loaded machine can house two accessible 5.25-inch drives, two accessible 3.5-inch drives (one a 1-inch-high device), and two internal 5.25-inch drives.

Ares sells its PCs through direct mail and has a generous service-and-support mix, including a 60-day return policy. The warranty covers parts for two years and labor for as long as the original owner has the computer. On-site service from TRW is free the first year. Bundled software includes the QA Plus diagnostics package, with a remote capability that helps technicians on the 24-hour, toll-free technical support line diagnose any problems.—BB

Ariel Design Inc.

Ariel 486DX2-50

Despite its relatively low price, the Ariel 486DX2-50's ISA tower is a high-performance machine. Turning in stellar performance on three of our five benchmark tests, it ranked first on memory, third on DOS-based video, and seventh on our processor test. Backed by typically good mail-order service-and-support policies, it is definitely a system to consider.

The Ariel lists for \$2,695 with 4MB of RAM and a 240MB Quantum IDE hard disk with a 256K disk cache. Maximum motherboard RAM is 32MB; system RAM is 64MB. Disk drive performance, typical for machines with the Quantum LPS240AT drive, was good but not among the fastest. Credit for the excellent processor and memory performance goes to the Micronics Baby Gemini-486DX2-50 motherboard with Micronics MIC461A/MIC462 chips, discrete RAM cache circuitry, and a Phoenix ROM BIOS. The 256K 20-nanosecond RAM cache uses direct-mapped write-through architecture.

The video subsystem was based on a Diamond SpeedSTAR Plus Hi-Color video adapter capable of 32,768 colors and a Tseng ET4000 chip set with 1MB



of video RAM—a combination best suited for DOS-based video. For those who would rather use Windows, Ariel offers the Diamond Stealth VRAM and the ATI Graphics Ultra cards, which come with graphics accelerators. A 14-inch ViewSonic 6 monitor, which is capable of 1,024-by-768 non-

interlaced resolution, completed the picture, but only at a 60-Hz refresh rate.

The Ariel has a nicely finished, rugged case with sturdy support pieces. Six 5.25-inch drive bays (four for removable me-

FACT FILE

Ariel 486DX2-50

Ariel Design Inc., 145 Webster St., Hanover,
MA 02339; 800-882-7435, 617-982-8800;
fax, 617-982-9095

List Price (Tested Configuration): \$2,695

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 256K cache

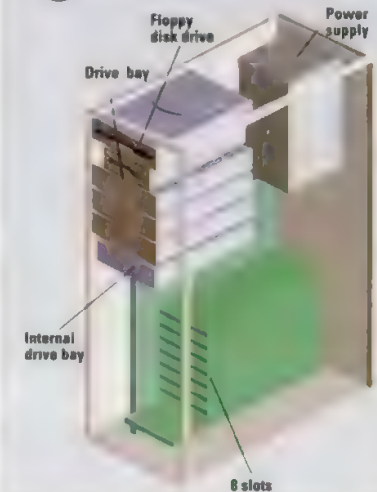
Disk drives and controller: Quantum 16-ms, 240MB
IDE hard disk, 256K cache, 1 2MB and 1 44MB floppy disk
drives

Display: Diamond 1,024-by-768 adapter with 1MB
RAM, ViewSonic 14-inch monitor, 60-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1

In Short: The ISA-bus Ariel 486DX2-50 is fast, well-con-
structed, and fairly priced—a good deal

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DELL 486P/50 i486DX2
50 MHz SYSTEM

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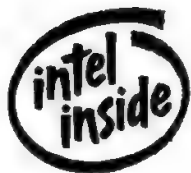
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dia) give the somewhat squat, 19.5-inch tower case moderate room for expansion. The motherboard has eight 16-bit ISA slots (six empty on our test unit) and one proprietary slot for a 32-bit memory card.

Ariel's service-and-support mix includes a one-year parts-and-labor warranty, free on-site service from TRW, and an 800 number for technical support.—BB

AST Research Inc.

AST Power Premium 4/50d

The AST Power Premium 4/50d lists for \$4,790 with a 210MB hard disk and 4MB of RAM. Its score on our DOS-based video test—third in our rankings—was its only exceptional performance result. It's a decent PC with a surprisingly roomy small-footprint desktop case. But although dealer discounts may bring a more reasonable price, this boils down to an average package that competes with units costing substantially less.

The AST uses the company's own EISA-bus motherboard with an Intel chip set and an upgradable plug-in CPU card that can hold an additional 16MB of RAM. With 64MB possible on the motherboard, the system maximum is 80MB. The flash ROM AMI BIOS is eas-



The \$4,790 AST Power Premium 4/50d

ily upgradable via floppy disk. Western Digital video circuitry is also built into the motherboard, saving an expansion slot and speeding video signal transmission.

The on-board video circuitry helped the AST score very high on the DOS-based video benchmark test, and its Graphics Winmark score was very decently midrange. Its hard disk, a 210MB IDE Quantum ProDrive LPS with a 256K disk cache, turned in an above-average

FACT FILE

AST Power Premium 4/50d

AST Research Inc., 16215 Alton Pkwy.,
Irvine, CA 92713-9658; 800-876-4278,
714-727-4141; fax, 714-727-9355

List Price (Tested Configuration): \$4,790.

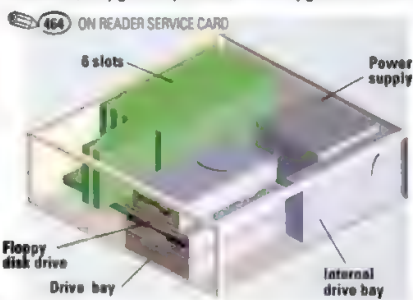
Memory and processor RAM cache: 4MB 70-ns SIMMs.

Disk drives and controller: Quantum 16-ms, 210MB IDE hard disk, 256K cache, 1.2MB and 1.44MB floppy disk drives.

Display: AST 1,024-by-768 local video with 1MB RAM, AST 14-inch monitor, 70-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The well-designed AST Power Premium 4/50d is a small-footprint EISA machine that offers decent performance, very good expansion, and an upgradable BIOS.



disk score. But lack of a secondary RAM cache held back its performance on the processor and memory tests.

Expansion options in addition to the high 80MB RAM capacity include six EISA card slots and bays for three 5.25-inch drives with removable media and two internal 3.5-inch devices. The well-designed case uses three finger screws to secure the cover, making the card slots and drive bays unusually accessible.

AST's one-year parts-and-labor warranty is backed by dealers and authorized service centers. On-site service contracts are sold through dealers at varying costs. AST has a technical support 800 number available weekdays and Saturdays as well as a 24-hour on-line BBS and automated technical-support fax systems.—OR

ATronics International Inc.

ATronics ATI-486/50DX2

The \$2,095 ATronics ATI-486/50DX2, one of the cheaper systems in this roundup, delivered performance and features typical of ultra-low-priced products.

The standard tower case is flimsy and difficult to open; more than one PC Magazine Labs staffer was heard yelping over this unit. Once open, it doesn't offer much for the sacrifice. Five drive bays—three horizontal 5.25-inch half-heights and two vertical 3.5-inch half-heights—are accompanied by a 250-watt power supply and an interior arrangement messy enough to delight Calvin and Hobbes. The processor lacks a heat sink and is buried beneath the drive bays, and a jungle of cables reside in the space above system RAM.

The ATronics' motherboard is based on an ISA bus and uses an AMI BIOS. It contains seven 16-bit slots, one 8-bit, and one proprietary slot for memory expansion above 32MB. The unit arrived with 4MB of RAM (64MB system maximum) supplemented by a 256K 20-nanosecond direct-mapped, write-back RAM cache. A removable 15-millisecond 212MB



The \$2,095 ATronics ATI-486/50DX2

Seagate ST-239A IDE hard disk with a 32K read-ahead buffer was paired with a Promise Technology DC-2030 16-bit hard disk controller with 1MB of write-back cache memory. Video was based on a 16-bit Mentor 1,024-by-768 video adapter with a Tseng ET4000 chip set and 512K of video RAM (the Orchid ProDesigner IIs and the ATI Graphics Ultra are also available). The monitor, a 14-inch ViewSonic 4E, had a flicker-laden 56-Hz refresh rate at 800-by-600, its highest noninterlaced resolution.

Video performance was predictably poor under DOS and Windows, while the unit's other scores were at best only average. ATronics' system manual is anorexic, and the product's packaging was below par. The removable hard disk is a keen business security consideration, but coupled with all the disappointments of this system, it can be classified as little

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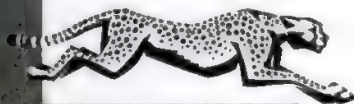
do is hit one key.

Or, if you prefer, click one mouse.

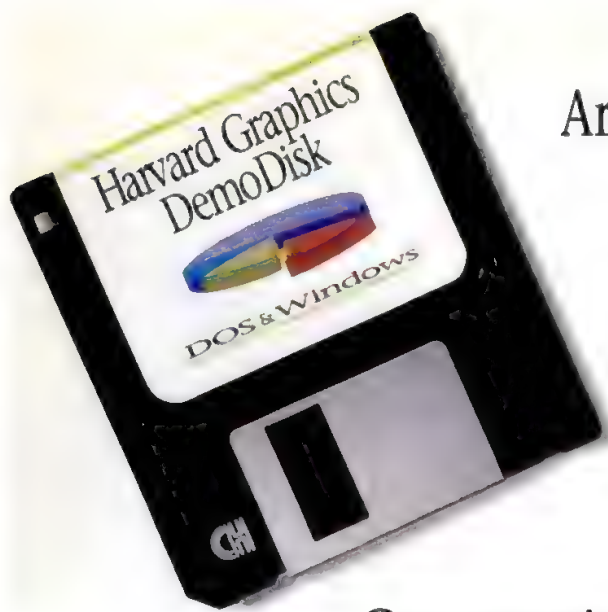
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FACT FILE

ATronics ATI-486/50DX2

ATronics International Inc., 45635
Northport Loop East, Fremont, CA 94538-
6415; 800-488-7776, 510-656-8400;
fax, 510-656-8560

List Price (Tested Configuration): \$2,095.

Memory and processor RAM cache: 4MB 70-ns.
SIMMs, 256K cache.

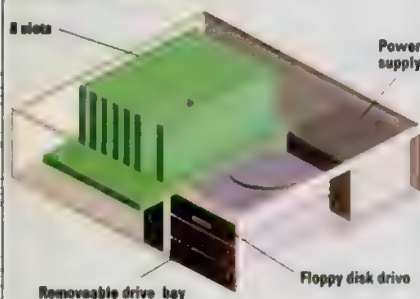
Disk drives and controller: Seagate 15-ms. 212MB
IDE hard disk, Promise Technology DC 2030 controller,
1MB cache, 1.2MB and 1.44MB floppy disk drives

Display: Mentor 1,024-by-768 adapter with 512K RAM,
ViewSonic 14-inch monitor, 56.2-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: Made with standard components, the ATronics
ATI-486/50DX2 exhibits performance commensurate
with its ultra-low \$2,095 price.

ON READER SERVICE CARD



more than a marketing gimmick.

ATronics sells the system with a one-year parts-and-labor warranty. On-site service from Nationwide Warranty Corp. costs \$99 the first year; for subsequent years, you deal directly with Nationwide. Technical support is available but not toll-free.—OR

Austin Computer Systems

Austin 486 WinStation DX2-50

The EISA-based Austin 486 WinStation DX2-50 manages to beat a good number of the machines in this roundup on price and performance. Though not outstandingly rich in features or options, the Austin has a mix of parts that complement each other to produce a low-priced system that can easily function as a general Windows workstation. Priced at \$2,990, it is not the optimal system for intensive graphics applications. However, sound operation and fine technical support mark

the Austin as a good entry-level EISA desktop PC for corporate buyers.

Austin's small-footprint desktop offers 4MB of RAM (64MB maximum) with 64K of processor RAM cache and a 12-millisecond 200MB Conner IDE hard disk driven by a DTC controller with a 64K cache. Its Super VGA display, which gave good video performance, is based on a Western Digital adapter paired with a 14-inch MAG monitor.

In this system, the CPU is mounted on a proprietary processor card with a fan atop the heat sink on the 486 chip. If there's fault with the layout of the system board, it's the tight positioning of the processor card next to the internal vertical drive bay mounting. They almost touch. Typical of the small-footprint design, there's limited drive bay space (three ac-

cessible, one internal), but the Austin's six EISA slots offer ample room for expansion. Only half can handle full-size cards, however.

The best-performing subsystem on the

Austin is the video. Using the Paradise M6V with a Western Digital 90C31 chip set and 1MB of fast video RAM, the system ranked sixth on our DOS-based video test. What's more, a Graphics Winmark score of 7.23 million places it in the top third of this

roundup for Windows graphics. The Conner CP-30204 hard disk gained no advantage from its DTC 2290 EISA controller, turning in a midrange score.

Austin's DX2 is covered by a standard one-year warranty. On-site service from GE Priority One is free the first year, with service extension fees, depending on the system configuration. The company takes technical questions and service contacts on a 24-hour call-back basis seven days a week.—Greg Pastrick

FACT FILE

Austin 486 WinStation DX2-50

Austin Computer Systems, 10300 Metric
Blvd., Austin, TX 78758; 800-338-1571;
512-339-3500; fax, 512-339-3592

List Price (Tested Configuration): \$2,990

Memory and processor RAM cache: 4MB 70-ns
SIMMs, 256K cache

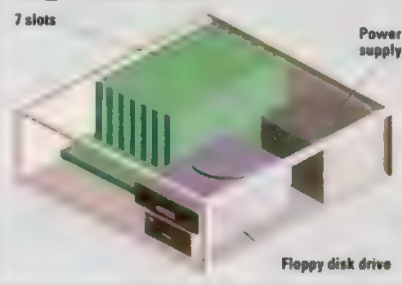
Disk drives and controller: Conner 12-ms. 200MB IDE
hard disk, DTC controller, 256K cache, 1.2MB and
1.44MB floppy disk drives

Display: Western Digital 1,024-by-768 adapter with
1MB RAM, MAG 14-inch monitor, 60-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1, ViruScan

In Short: The Austin 486 WinStation DX2-50 offers
enough features and performance to handle standard
business tasks at an attractive \$2,990 price

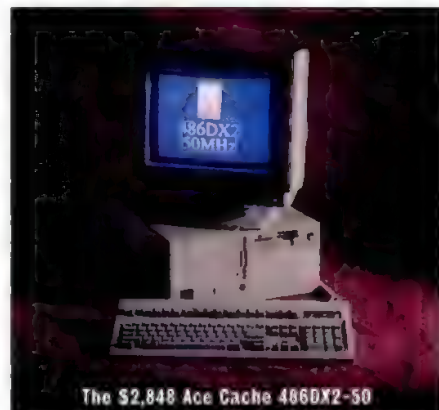
ON READER SERVICE CARD



Axik Computer Inc.

Ace Cache 486DX2-50

Axik Computer's Ace Cache 486DX2-50 lists for \$2,848 with 4MB of RAM and a 212MB hard disk. The small-footprint desktop Ace Cache's performance is good and its price is decent. The lack of on-site service, however, even as an option, argues against buying this mail-order system.



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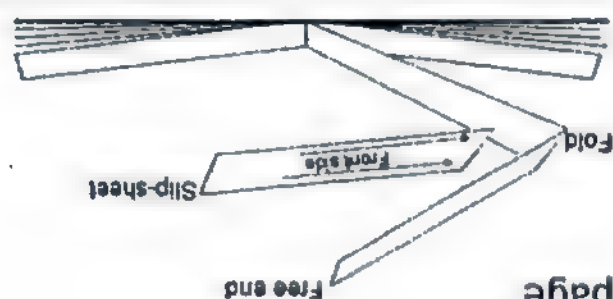
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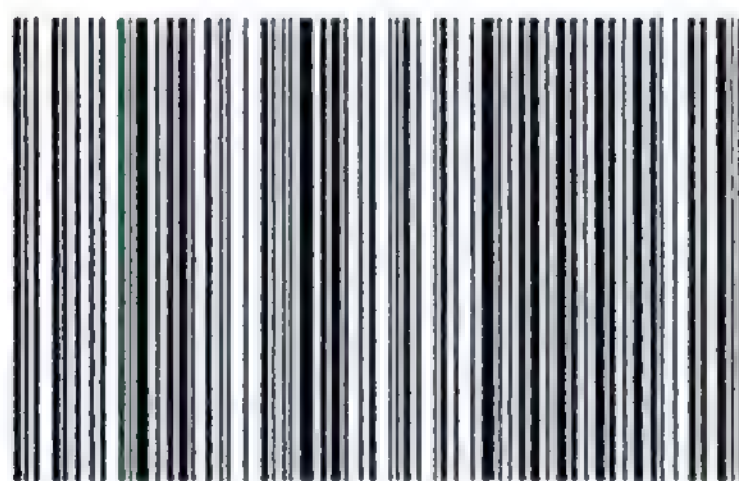
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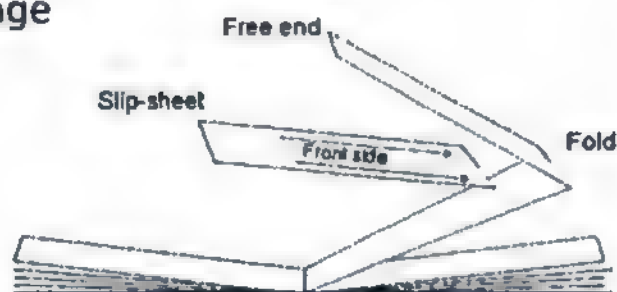


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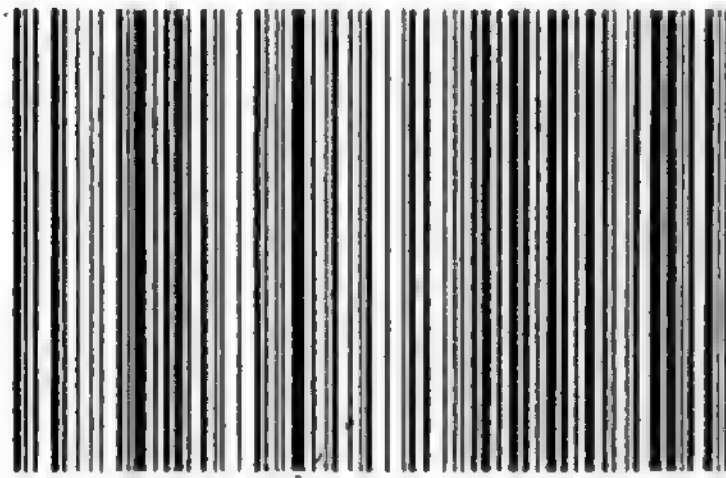
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- 8 Open expansion slots (seven ISA and 1 Local Bus).
- Small footprint chassis, 6 drive bays
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FACT FILE

Ace Cache 486DX2-50

Axik Computer Inc., 1031 E. Duane Ave.,
Suite F, Sunnyvale, CA 94086; 800-234-
2945, 408-735-1234; fax, 408-735-1437

List Price (Tested Configuration): \$2,848.

Memory and processor RAM cache: 4MB 70-ns.
SIMMs, 256K cache.

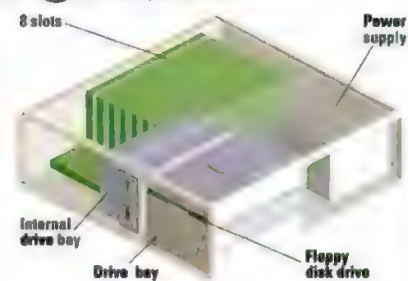
Disk drives and controller: Maxtor 23-ms. 212MB
SCSI hard disk, Promise Technology controller, 1MB
cache, 1.2MB and 1.44MB floppy disk drives.

Display: Orchid 1,024-by-768 adapter with 1MB RAM,
Optique 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The Axik Ace Cache 486DX2-50 features good
price and performance, which are offset by a cheap-
looking case and no on-site service.

ON READER SERVICE CARD



The Ace Cache's ISA-bus motherboard has an OEM version of the Contaq chip set, a Contaq cache controller, a AMI ROM BIOS, and a proprietary 32-bit local-bus video slot. The video sub-system uses a standard Orchid Fahrenheit 1280° board with an S3 video accelerator and a 14-inch Optique 1000 monitor.

The unit's processor and memory scores were in the top echelon, thanks to the 256K direct-mapped RAM cache. Disk performance also was very good. A 1MB cache on the Promise Technology DC-2040 SCSI controller overcame the limitation of the Maxtor hard disk's nominal 23-millisecond access-time rating. Its Graphics Winmark performance was good because of the S3 chip, but, as usual, its

DOS-based video performance suffered.

The system case felt a bit flimsy. The case cover is held down by small screws on the sides rather than on the back. Five drive bays hold three 5.25-inch accessible drives, a 1-inch accessible bay, and a 1-inch internal 3.5-inch bay. In addition, there are eight 16-bit ISA slots, one of which doubles as a 32-bit local-bus video slot. All of the PC's 32MB of RAM maximum fits on the motherboard.

Sold by mail-order, the Ace Cache 486DX2/50 comes with a slightly better-than-average, 13-month parts-and-labor warranty. Extended warranties are \$99 per year, but no on-site service is available even as an extra-cost option. If system problems can't be solved via an 800-number support line, you have to ship the computer to California.—BB

C² Micro Systems Inc.

C² Saber DX/2

C² Micro Systems sells its C² Saber DX/2 for \$3,125 with 4MB of RAM and a 212MB hard disk. The full-size tower-case ISA-bus computer performed well in general but was hampered by a small, 64K RAM cache on our processor test. Drive expansion room is excellent, and the price is right: Since this system is sold through dealers and VARs, you can probably get a discount.

The Saber uses a Magnum Cache 486 motherboard from ERI with an AMI BIOS, and a Symphony chip set and cache controller. The 64K RAM cache has a direct-mapped, buffered write-through architecture. Maximum RAM is 64MB. The Diamond Computer Stealth VRAM 1,024-by-768 adapter with 1MB RAM was paired with an ADI 17-inch monitor.

As with other systems reviewed here, the S3 chip-based Diamond Stealth card generated a good Windows graphics score accompanied by an inevitably middle-of-

the-road DOS-based video score. A Promise Technology caching disk controller with a 2MB cache coupled with an ALPS 13-millisecond IDE hard disk helped the system to score in the top ten for disk performance.

The Saber's full-size case has an attractive design and solid construction, making it a good candidate for use as a low-cost file server or engineering workstation. The case has eight drive bays, four of which accept removable media.

Sold through dealers and VARs, C² offers reasonable service and support policies, including a one-year parts-and-labor warranty with on-site service, free the first year, from Nationwide Warranty Corp. The one compromise on support is a

FACT FILE

C² Saber DX/2

C² Micro Systems Inc., 47560 Seabridge Dr.,
Fremont, CA 94538; 800-659-9997,
510-683-8888; fax, 510-683-8662

List Price (Tested Configuration): \$3,125.

Memory and processor RAM cache: 4MB 70-ns.
SIMMs, 64K cache.

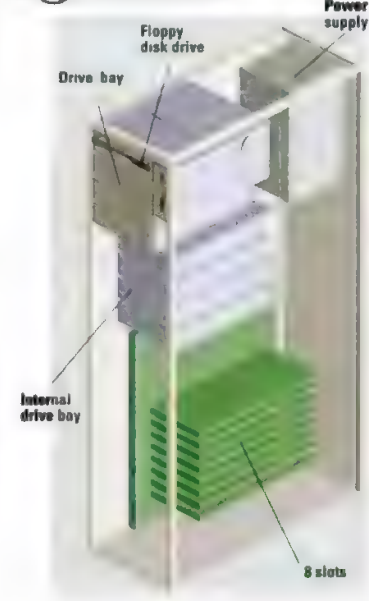
Disk drives and controller: Alps America 13-ms.
212MB IDE hard disk, Promise Technology controller,
2MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB
RAM, ADI 17-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The C² Saber DX/2 combines good performance, a good price, and expansion room.

ON READER SERVICE CARD



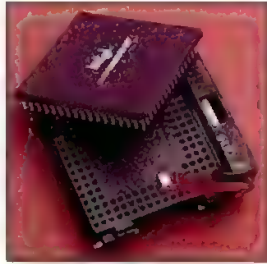
■ DX2 vs. OverDrive: *Do You Want Your Speed Boost Now or Later?*

by Oliver Rist

In this roundup, you will find 63 examples of Intel's speed-doubler, or clock-doubler, DX2 processor. The DX2 CPUs reviewed here are part of what are essentially 25-MHz 486 PCs, but the CPUs execute internal instructions at 50 MHz. First cousin to the DX2 is Intel's OverDrive CPU. The main difference between these two similar chips is that the DX2 CPU is a factory-installed, clock-doubled CPU, while the OverDrive chip is an install-it-yourself clock-doubling upgrade.

If you have a 16-, 20-, or 25-MHz 486SX PC, it probably has an empty OverDrive socket inside. This socket was previously called a PUS (processor upgrade socket), which sounded terrible, so Intel renamed it PES (for processor or performance enhancement socket), and finally settled on the name OverDrive. The earliest 486SX systems had an empty 80487SX math coprocessor socket, and a few systems, to keep costs down, had only the main CPU socket. In all cases, you can upgrade by simply plugging in an OverDrive chip.

What makes the OverDrive CPU so attractive is that although it's basically the same thing as a DX2 chip, you don't have to get it right away. You can first try a more sedate (and economical) 25-MHz 486 on your applications. If that's not enough, or if your needs change, you can significantly increase your PC's performance without all the old CPU upgrade costs and hassles—plugging in a modular CPU card, adding a turbo card, swapping motherboards, or buying a brand-new



system. OverDrive chips, and the motherboards built for them, are standardized on this platform. No screw-drivers, no calls to tech support, and hopefully no BIOS upgrades; it's just an off-the-shelf box that

comes with the chip and documentation. Plug it in and you're running at twice your usual speed—well, almost.

What makes OverDrive technology unattractive is the price compression among system types, making it only a little more expensive to buy the faster system—for instance, a 486DX2/50 rather than a 486SX/25. The difference may be only \$200 to \$300, half what it will cost to upgrade later.

486 HISTORY

After Intel's 486DX, the company introduced the 486SX chip, which lacked the math coprocessor portion of the DX. For those who wanted floating-point math capabilities, Intel offered an 80487SX math coprocessor upgrade. The 80487SX was actually a

math unit. There are a number of different OverDrive processors. Prices range from \$549 to \$699, and they fit a variety of sockets including the new ZIF (zero-insertion-force) sockets, which make upgrading literally as easy as dropping in the chip. The OverDrive offerings include:

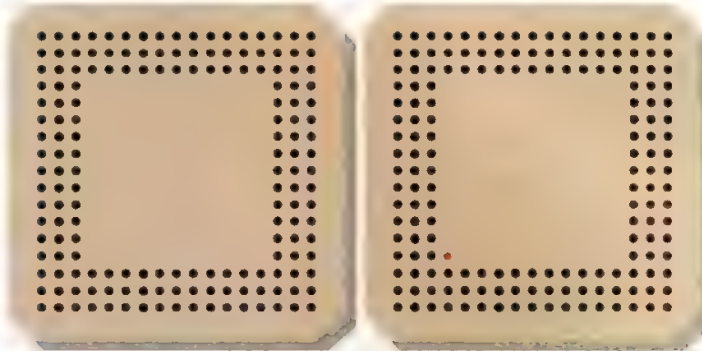
- OverDrive CPUs for the OverDrive sockets of 16-, 20-, and 25-MHz 486SX systems, making them 33-, 40-, and 50-MHz systems, respectively.
- OverDrive variants for the 486SX sockets.
- OverDrive replacement chips for systems with no OverDrive or 80487SX sockets. You pull the original 486SX CPU with a chip puller (or by undoing the ZIF socket level) and swapping in the OverDrive version.
- OverDrive CPU replacements (coming shortly) for 25-MHz and 33-MHz 486DX (not 486SX) machines that turn them into 50- and 66-MHz DX2 systems.

Intel has just released a 66-MHz DX2 chip mated to a 240-pin socket for a P5 OverDrive chip—though Intel won't yet confirm this. While a P5 version of the OverDrive CPU would significantly increase your PC's performance, it cannot match the power of a true P5 because a 486 runs on a 32-bit bus, while a true P5 chip will be a 64-bit processor. Presently,

Intel sells the OverDrive chip solely through distributors, such as Comp USA, Fry's, Compucom, Elek Tek, and Sears.

Does the OverDrive chip give true 50-MHz 486DX performance? No, but it's close. Intel claims 1.8 times the performance of a 25-MHz 486. This coincides with the performance of factory-installed DX2s seen in this roundup, which

performed at 96 percent the speed of a true 50-MHz 486DX on PC Magazine Labs' processor benchmark test. Once an OverDrive chip is plugged in, it disables the former CPU, adds its own



A standard 486/486SX socket appears on the left. Intel's "vacancy" socket (right) contains an extra pinhole to accommodate a 487SX or an OverDrive processor (shown in the photo with a ZIF socket).

complete CPU, not just the math unit; it disabled the original 486SX CPU.

The OverDrive chip, like the manufacturer-installed DX2 chip, contains both the main CPU and the

floating-point capability, pumps core-logic processing to 50 MHz, and takes over as the central processor. Your local system bus, however, remains running at the original speed. Thus, 25-MHz signals (in the case of a 25-MHz bus, for example) are received by the OverDrive CPU's PLL (phase-locked loop) circuit and analog amplifier. These amplify the 25-MHz bus signals to 50 MHz so the CPU can compute at that level.

Although the OverDrive's internal 8K cache and its floating-point and integer components all run at true 50 MHz, all external communications, such as memory interactions, take a performance hit. This hit can take many and even multiple forms. Part of this is caused by the slower system bus and the PLL/amplifier translation; the rest is largely a function of memory.

If you're buying a 486SX with an eye toward an OverDrive future, make sure your SX motherboard is capable of a number of different memory functions. First, it should have a secondary external SRAM cache of at least 128K. Because SRAM runs at around 20 nanoseconds instead of DRAM's 70 ns (with a 130-ns cycle time), it will slow the 50-MHz CPU down far less than if it had to wander all the way over to main memory. Though there are motherboard manufacturers that make modular secondary caches, these are not the norm, and your upgrade price could cross the \$1,000 threshold. Second, try to obtain a board whose memory controller is capable of burst mode. This is a high-speed transfer rate rarely used by older 25-MHz 486SXs because they were never meant to run that fast. But if you're going to upgrade to 50-MHz later on, you will need this fast data transfer between SRAM and CPU or you'll slip even farther away from a true 50-MHz pace.

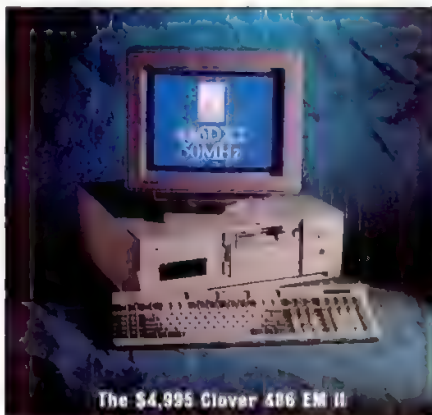
Granted, none of these decreases will be radical, and your 50-MHz performance will always outshine your current 25-MHz 486. But if you're willing to invest between \$600 and \$700 in higher performance, you might as well do it right. □

toll technical support line available only during weekday business hours.—BB

Clover Computer Systems Inc.

Clover 486 EM II

The Clover 486 EM II, sold by Clover Computer Systems for \$4,995, is a standard desktop-size EISA computer. But it comes with a screamingly fast 212MB Maxtor ESDI hard disk and Mylex 4MB caching disk controller. The combination is a little expensive, but if you need fast



performance, this may be your best bet for a DX2.

The Clover's Mylex motherboard uses a Mylex ROM BIOS, discrete-logic CPU support circuitry, and an Intel controller for the 128K 25-nanosecond direct-mapped buffered write-through RAM cache. The video subsystem pairs a 1MB Quick Path Cyclone XG video adapter and an S3 graphics accelerator chip with a 14-inch ADI that has a 72-Hz refresh rate at 1,024-by-768 resolution.

The Maxtor SCSI hard disk linked with the 4MB cache Mylex controller placed first on PC Magazine Labs' disk test. Its processor and memory scores were also good, while its video score was typical of the S3 graphics accelerator.

The well-finished desktop case has room for six drive bays: two 5.25-inch and two 3.5-inch drives are accessible; two more 5.25-inch drives are internal. The 32MB RAM maximum is lodged on the motherboard, which also has eight EISA slots (three empty on our system).

Clover sells computers by mail order and through dealers. The standard warranty covers parts and labor for one year. On-site service is optional at \$150 for the first year from Nationwide Warranty

FACT FILE

Clover 486 EM II

Clover Computer Systems Inc., 1430 Koll Circle, #102, San Jose, CA 95112; 800-925-6837, 408-436-0444; fax, 408-436-0494

List Price (Tested Configuration): \$4,995.

Memory and processor RAM cache: 4MB 60-ns. SIMMs, 128K cache.

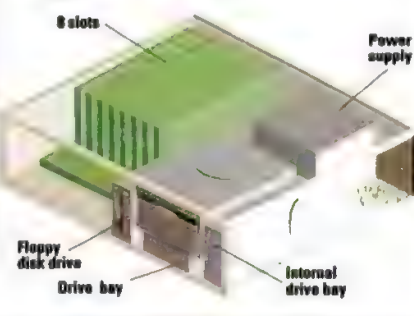
Disk drives and controller: Maxtor 15-ms. 212MB SCSI hard disk, Mylex controller, 4MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Quick Path 1,024-by-768 adapter with 1MB RAM, ADI 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The Clover 486 EM II costs a bit more but delivers super all-around performance.

ON READER SERVICE CARD



Corp. Extended on-site service contracts cost 10 percent of the original system price. If you need to contact Clover for technical support, an 800 number is available during weekday business hours only.—BB

Club American Computers Inc.

Club Falcon 450 DX2

The Falcon series of ISA-based systems covers virtually all existing Intel microprocessors and clock speeds from the 386DX/25 to the 486DX/50. As such, Club American Computers's 50-MHz Club Falcon 450 DX2 is simply the latest processor upgrade module in a lineup that is sure to include a 66-MHz DX2 by the time you read this review. Except for the processor module, little else sets this tower system apart from any other Falcon tower in the line—unless you consider its bargain price.

It is hard to dismiss a flexible, functioning machine that costs \$3,080 for 8MB of RAM (64MB maximum), 256K of pro-

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[†] See your dealer for warranty details

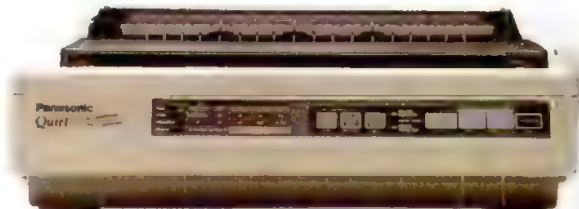
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ANYTHING LESS.**



The KX-P2123, a 24-pin with ATM® and color option.



The KX-P2180, a 9-pin with color option. ATM® not available.



The KX-P2624, a 24-pin with ATM®. Color option not available.

cessor RAM cache, a 240MB Quantum ProDrive LPS with a Promise Technology controller holding a 256K disk cache, and a standard-issue Club American 14-inch monitor with Diamond SpeedSTAR adapter.

It is equally hard to dismiss a big case with wheels that make it look like a platform begging to be loaded up with software and accessories—even if it does have a cheap plastic faceplate and drive cover. With a total of seven drive bays, the Falcon has a large-enough power supply (250 watts) to handle just about any expansion device you throw at it.

The system is supported by Club's long list of peripherals and upgrades, which makes system shopping and swapping a relatively easy chore. However, the Falcon offers performance measures strong enough to make it competitive with its peers even in its tested configuration.

The Falcon uses Club's own FA118 cache controller to achieve good memory and processor performance. This ISA-based machine, like many others in this roundup, had a cached (256K) Quantum ProDrive LPS 240 IDE hard disk that gives good disk performance. The Falcon's Tseng chip-based ET4000 Diamond SpeedSTAR video adapter, which favors video performance under DOS, turned in an average video score and came in predictably low on our Graphics Winmark test.

The Falcon would be better served by a higher-end graphics card if Club expects buyers to take it as a serious Windows platform. A better choice might be Club's 15-inch NEC MultiSync 4FG and Diamond Stealth VRAM options.

Club's standard one-year warranty on

FACT FILE

Club Falcon 450 DX2

Club American Computers Inc., 3401 W. Warren Ave., Fremont, CA 94539; 800-524-2582, 510-683-6688; fax, 510-490-2687

List Price (Tested Configuration): \$3,080.

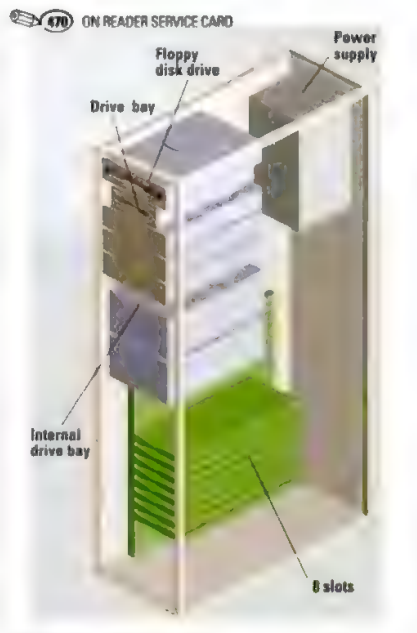
Memory and processor RAM cache: 8MB 60-ns. SIMMs, 256K cache.

Disk drives and controller: Quantum 16-ms. 240MB IDE hard disk, Promise controller, 256K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB RAM, Club 14-inch monitor, 70-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: Club American Computers' upgradable ISA-tower platform serves every Intel microprocessor from the 386/25 to the 486/50, with a good price and DX2 performance.



parts and labor backs this PC with GE Priority One on-site service and costs \$49. You can buy two- or three-year service contract extensions for \$249 and \$275, respectively. Club also maintains a leasing program with the addition of 100 percent financing and purchase options.—GP

Compaq Computer Corp.

Compaq Deskpro 50M

Compaq's 50-MHz DX2 addition to its Deskpro/M family has a tight, clean design. An upgradable processor card, a proprietary memory module with a 72MB

RAM maximum, and a QVision video accelerator make this EISA-bus machine a premium system all the way around. But despite Compaq's aggressive efforts to lower pricing, you still pay a premium price for this unit: \$4,897 for 8MB of RAM, a 212MB Conner fixed hard disk, two floppy disk drives, and the superior Compaq QVision Super VGA adapter and a 15-inch monitor.

The Compaq Deskpro 50M is a solid



platform for graphical environments in a small-footprint case with two proprietary slots for processor and memory cards and five EISA slots, four of which were free in our test unit. Though diagnostic and support disks for NetWare, Windows, and OS/2 come with the system, along with complete operating instructions and technical information, you don't get Microsoft Windows 3.1 or OS/2. What you do get is a new high mark in Windows graphics performance unmatched by the rest of the competition in a well-built, flexibly upgradable design.

The Compaq's outstanding Graphics Winmark score of 19.16 million is the highest we've seen so far in our new Windows testing. The graphics video performance of the proprietary QVision display EISA subsystem is double the score turned in by the number-two system in our review. And unlike many of the video subsystems in this roundup that compromise DOS video performance to gain fast Windows graphics, the Compaq's second-place finish proves it a strong DOS video performer, too.

Processor and memory performance was also good due to the Compaq's 256K of two-way set-associative RAM cache. The only weak link was the low-scoring 212MB Conner CP32016 IDE hard disk built to Compaq's specifications. Faster



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FACT FILE

Compaq Deskpro 50M

Compaq Computer Corp., 20555 State Hwy.
249, Houston, TX 77070; 800-231-0900,
713-370-0670

List Price (Tested Configuration): \$4,897.

Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.

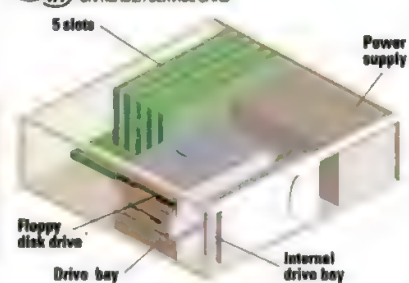
Disk drives and controller: Conner 16-ms. 212MB IDE hard disk, Compaq controller, 1.44MB floppy disk drive.

Display: Compaq 1,024-by-768 adapter with 1MB RAM, Compaq 15-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0.

In Short: The EISA-based Compaq Deskpro 50M's QVision video technology produced the best Windows graphics performance yet measured by PC Magazine Labs.

ON READER SERVICE CARD



and larger hard disks from the company's long list of expansion options can add \$1,000 to \$2,200 to the already high price of the tested configuration.

Compaq offers a standard one-year warranty on all parts and labor for its systems. On-site service calls are handled by a list of third-party companies and authorized dealers. First-year service comes free, but Compaq offers no extended service contracts. A toll-free line for service and technical support is available weekdays.—GP

Compudyne Products

Compudyne 4DX/250

The \$1,999 Compudyne 4DX/250 is one of the cheapest systems in this roundup. But unlike most of its low-cost competition, it delivered remarkably consistent and hassle-free performance.

The small-footprint desktop case contains five drive bays: three front-accessible 5.25-inch half-heights and two internal 3.5-inch half-heights. The latter,

mounted vertically, hold the system's hard disk. The power supply puts out 200 watts.

The ISA-bus motherboard has five 16-bit slots, two 8-bit slots, and one 32-bit EISA slot. Both the processor and system RAM chips are easily reached, but the I/O configuration is troubling: A second I/O board was included to provide a game port, while cabling from the other board to the parallel port opening in the case cost yet a third slot.

The unit features an AMI BIOS, 4MB of RAM (32MB motherboard maximum, 64MB with optional memory card), 128K of 25-nanosecond four-way set-associative processor RAM cache, and a 212MB IDE Western Digital Caviar AC2200 hard disk with an internal 64K buffer (Western Digital 120MB and

Seagate 330MB units are also available). Video consists of a 16-bit Compudyne/STB Whiplash video card based on the S3 accelerator with 1MB of video RAM and a 14-inch Hyundai 1,024-by-768 monitor with a mediocre refresh rate of 62 Hz.

Gripes include analog image controls

that are awkwardly mounted on the rear of the Hyundai monitor. The 101-key keyboard was tragically flimsy, but the mouse proved adequate. Compudyne's documentation was strange: It apparently devoted more of an effort to providing usable DOS 5.0 and Win-

dows documentation bearing its name than it did to the pages covering its own system. Some almost useful media clippings regarding smart working techniques were also included. Utility disks were limited to the GUI accelerator.

Though the Compudyne package's quality was slightly erratic, its performance was certainly consistent. All tests fell within the median group, though the processor and memory scores were surprisingly low-end considering that this was one of the few systems to use a four-way set-associative processor cache—another example that having the technology isn't enough unless it's properly implemented.

Compudyne offers its customers a one-year warranty on parts and labor; on-site service from Dow Jones is free the first year. The technical support line is a toll-free call.—OR

FACT FILE

Compudyne 4DX/250

Compudyne Products, 15151A Surveyor Rd., Addison, TX 75244; 800-932-2667, 214-702-5600; fax, 214-702-0300

List Price (Tested Configuration): \$1,999.

Memory and processor RAM cache: 4MB 70-ns. SIMMs; 128K cache.

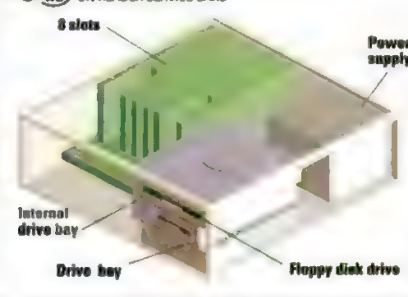
Disk drives and controller: Western Digital 14-ms. 212MB IDE hard disk, Compudyne Super IO controller, 1.2MB and 1.44MB floppy disk drives.

Display: Compudyne/STB 1,024-by-768 adapter with 1MB RAM, Hyundai 14-inch monitor, 62-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: A rock-bottom price combined with midrange performance make this a viable desktop for the cost-conscious.

ON READER SERVICE CARD



Computer Sales Professional

Computer Sales Professional Pro 486DX2/50

At \$1,999, the Computer Sales Professional Pro 486DX2/50 is an average to slightly below-average performer, but it offers a decent feature set and a low, low price.

The case is one of this system's big pluses. Inside a slightly oversize, 18.8- by 8.8- by 16.8-inch mini-tower case, the Pro



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Family and household use Professionally working at home Commercial or business

2. Number of PCs installed at this site. _____

3. Type of computer platforms used.

XT _____ 386 _____ Mac _____

AT _____ 486 _____ Other _____

4. Number of office workers. _____

5. Types of equipment acquisition planned in the next 12 months. _____

Are you planning to make a buying decision in the next 90 days? _____



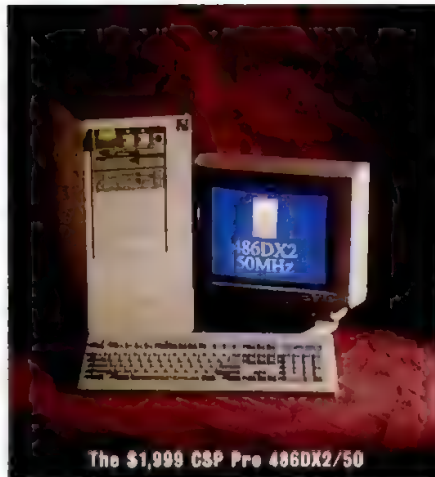
Send or Call, 1-800-446-2497

Fax 1-814-237-5416

U1C4

486DX2/50 manages to conceal eleven drive bays: six 5.25-inch half-heights and five 3.5-inch slimlines. The system's power supply puts out 200 watts and has five connectors. The only fault of the internal arrangement is that three of the eight ISA-bus slots are blocked and can accept only half-length cards because system memory is located directly behind them.

The Symphony motherboard contains eight 16-bit ISA slots and has a Diamond



The \$1,999 CSP Pro 486DX2/50

VGA Hi-Color video adapter carried a DOS-oriented Tseng ET4000AX chip with 1MB of video RAM; Windows users may specify the graphics-oriented Diamond Stealth instead. The 14-inch Tatung CM-14UAS monitor provides a 70-Hz refresh rate at 1,024-by-768 resolution; for heavy graphics use, opt for the 15-inch Hitachi CM-1584 or 20-inch Hitachi CM-2085 instead. All the ports—one parallel, two serial, and one game—are run off an I/O card.

Ergonomically, the Pro 486DX2/50 was competently average. Though the Tatung monitor had all four image controls (horizontal/vertical position and horizontal/vertical size), it placed the two phase controls on a pair of rear-mounted, recessed twist knobs. The system documentation wasn't as thin as some others but lacked forethought. With sections titled "Connecting the Power Cord" and "Connecting in the Mouse," the company could never be accused of overlooking the obvious, but some important information, such as the manufacturers and model types of the motherboard and cache chip set, was left out.

Like most of these units, the Pro 486DX2/50 had face-in-the-crowd performance scores, so performance isn't an issue here, since average speed-doubled performance is fast enough for most. The secondary RAM cache did its part, but

video and disk numbers fell toward the bottom of the group.

Computer Sales Professional ships this unit with a one-year parts-and-labor warranty and free on-site service. Technical support is toll-free.—OR

Comtrade Express

Comtrade 486 EISA WinStation

Maybe you haven't yet heard of Comtrade Express, but if the company manages to get its packaging act together, you will: The \$2,975 Comtrade 486 EISA WinStation already has the performance issue licked.

The Comtrade's solidly made standard tower case contains seven drive bays (five front-accessible and two internal) and a 230-watt power supply with four connectors. Power, turbo, and reset switches are also front-mounted.

The EISA motherboard, an ETI Warp-33 by Elisa Technology, has seven slots. Three of these are proprietary: one for the upgradable CPU module and two

for future local-bus implementations. The unit's 4MB of RAM, which can easily be expanded to 32MB on-board, come backed by a 20-nanosecond, 256K processor RAM cache with a direct-mapped write-back architecture. There is also a 240MB IDE Quantum LPS240-AT hard disk with a

256K read-ahead buffer coupled to an ACM DC-620 EISA caching disk controller with a 2MB cache. Video, based on a 16-bit ISA Diamond Stealth VRAM adapter with an S3 graphics accelerator and 1MB of video RAM, is coupled with a 14-inch CTX CPS-1460 ProScan monitor that can go up to 1,024-by-768 at a VESA-compliant 70-Hz refresh rate. The excellent 15-inch MAG MHX-15 monitor is also available.

Performance is the Comtrade's strong point. It scored second on the disk test, and its S3 chip-based video adapter managed a high Windows mark. Its 256K sec-



The \$2,975 Comtrade 486 EISA WinStation

FACT FILE

Computer Sales Professional Pro 486DX2/50

Computer Sales Professional, 13 Clyde Rd.,
Somerset, NJ 08873; 800-950-6660,
908-560-1143; fax, 908-356-5005

List Price (Tested Configuration): \$1,999.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache.

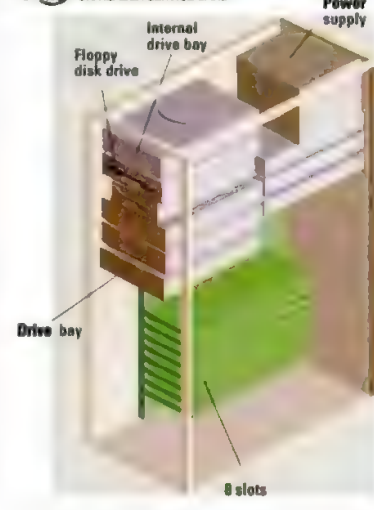
Disk drives and controller: Western Digital 14-ms. 212MB IDE hard disk, DFI controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB RAM, Tatung 14-inch monitor, 70-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

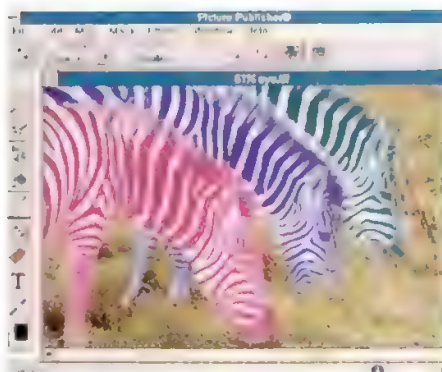
In Short: A decent feature set and a low \$1,999 price offset this PC's dip in performance.

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CIRCLE 361 ON READER SERVICE CARD

FACT FILE

Comtrade 486 EISA WinStation

Comtrade Express, 15314 E. Valley Blvd.,
City of Industry, CA 91746; 800-969-2123,
818-961-6688; fax, 818-369-1479

List Price (Tested Configuration): \$2,975.

Memory and processor RAM cache: 4MB 60-ns.
SIMMs, 256K cache.

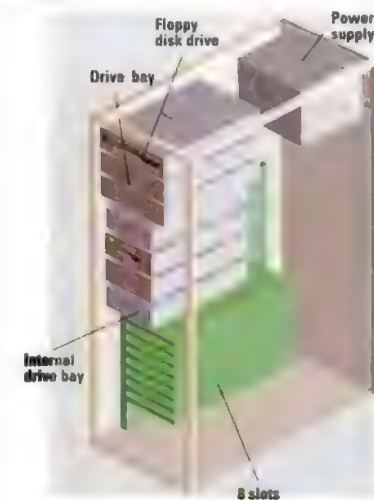
Disk drives and controller: Quantum 15-ms. 240MB
IDE hard disk, 2MB cache, 1.2MB and 1.44MB floppy disk
drives.

Display: Diamond 1,024-by-768 video adapter with
1MB RAM, CTX 14-inch monitor, 70-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: Excellent design is marred by poor marketing,
incomplete documentation, and a weak package.

ON READER SERVICE CARD



ondary RAM cache also managed above-average scores on the processor and memory tests.

Packaging is the Comtrade's weak point. The CTX monitor and 101-key keyboard are both subpar. But, more important, the unit had almost no documentation. Only a skinny leaflet covering the system board was included—no information on the hard disk, video board, controller card, warranty, or sales or tech-support policies. If Comtrade manages to pull together on its package design while keeping its price point, this company could really be going someplace.

Comtrade sells this PC only directly but compensates with an excellent price, a two-year parts-and-labor warranty, free first-year on-site service from Nationwide Warranty Corp., and toll-free technical support.—OR

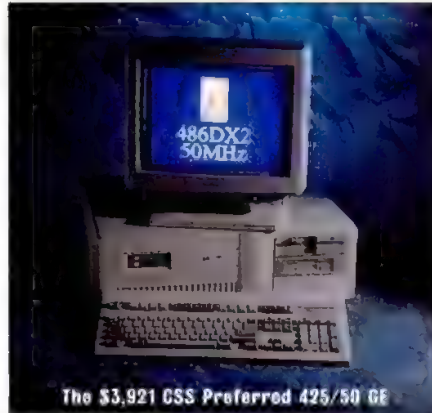
CSS Laboratories Inc.

CSS Preferred 425/50 GE

CSS Laboratories put together its 50-MHz DX2 with an interesting piece of proprietary technology—namely, its own local-bus video adapter. An admirable attempt to introduce new architecture into the standard desktop design failed to produce any measurable performance advantage.

As tested for our roundup, the \$3,921 CSS Preferred 425/50 GE included

4MB of system memory, a 128K RAM cache, a 202MB Maxtor IDE hard disk with a 64K buffer governed by a VLSI controller, and a ViewSonic 6 monitor



FACT FILE

CSS Preferred 425/50 GE

CSS Laboratories Inc., 1641 McGaw Ave.,
Irvine, CA 92714; 800-966-2771; 714-852-
8161; fax, 714-852-0410

List Price (Tested Configuration): \$3,921.

Memory and processor RAM cache: 4MB 80-ns
SIMMs, 128K cache.

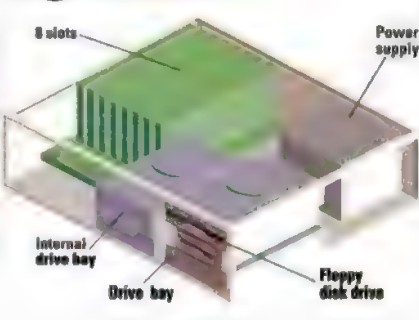
Disk drives and controller: Maxtor 19-ms. 202MB IDE
hard disk, VLSI controller, 1.2MB and 1.44MB floppy disk
drives.

Display: CSS 1,024-by-768 adapter with 1MB RAM,
ViewSonic 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0.

In Short: The CSS Preferred 425/50 GE is an interesting
attempt at presenting nascent local-bus technology in a
desktop package, but performance gains are lacking.

ON READER SERVICE CARD



connected to the company's own local-bus video card.

CSS promotes the system as being designed around this local-bus video solution, which plugs into an EISA-style slot on motherboard. The local-bus video card holds a Maxgraphic-32 controller, the S3 graphics accelerator, and 1MB video

RAM. Since its Graphics Winmark score shows it to be performing at speeds equal to those of any S3 chip, there's no apparent performance advantage here.

The local-bus video card turned in a very good Graphics Winmark score of 7.55 million. Still,

this result does not match the expected performance of local-bus technology, a common problem in this roundup and attributable in part to immature Microsoft Windows 3.1 drivers. True to form, though, the performance of the S3 chip on our DOS-based video ranks this system in the lower third of the machines evaluated. Also disappointing was the 60-Hz refresh rate of the ViewSonic 6 monitor; you would think CSS Labs would offer a better monitor with its local bus video.

The Preferred's 19-millisecond Maxtor LXT-213A IDE hard disk scored poorly on our disk test, owing in part to the lack of a caching disk controller. Processor and memory scores ranked well within the bottom third of the test group. But, as with the local-bus video card, there appears to be no performance advantage to using the proprietary "silent-bus" slot for the CSS memory expansion card, which holds up to 64MB of RAM in 4MB increments.

In all other ways, the Preferred is not unlike many of the desktop systems reviewed here. The system does have a jumbo 300-watt power supply and a total of five drive bays for mass storage growth. What's more, its service-and-support policy warrants the system for 18 months and gives a year of free on-site service directly through CSS Laboratories. Third-party service and technical support is handled through CSS's toll-free line.—GP

The Monitor for Windows

The ViewSonic 7 was the original, "Big Screen for Windows" monitor. Here's what some editors said about it:

Byte (May 1992) "... *The ViewSonic 7 gets our vote as the best overall monitor*".

Windows Magazine (May 1992) "... *The ViewSonic 7 is the best value in the test*".

Infoworld (Sept 1991) "*The ViewSonic 7 captured the top spot in our tests*".

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The two larger monitors both have a flat square screen and microprocessor-based memory with programmable preset modes for screen adjustments. And, for a safer environment, they are MPR-II certified for low radiation.

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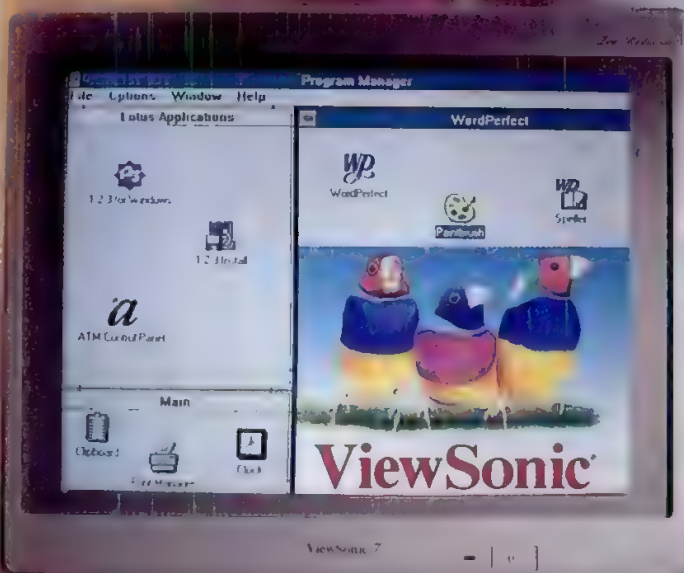
COMPACT 14" ViewSonic 5E



MID RANGE 15" ViewSonic 6FS



FULL SIZE 17" ViewSonic 7



Dataworld Inc.

Dataworld Data 486/DX2-50

The \$2,675 Dataworld Data 486/DX2-50 came in a large tower case, implying file-server aspirations. But the system was configured as a typical desktop PC to conform to *PC Magazine's* request for a 4MB RAM, 200MB hard disk system. Unfortunately, it was configured haphazardly.

The standard tower case contains five front-accessible and two internal drive bays, as well as a 230-watt power supply with five connectors. The case has a problem: The rear disk bays block access to the SIMM sockets, forcing you to remove the controller card to get at the memory.

An ISA seven-slot ELT 425ECB motherboard uses an AMI BIOS and a combination ETEQ and SIS chip set. 4MB of system memory can be expanded to 64MB maximum and are backed by only 64K of processor RAM cache (direct-mapped write-through). The popular 212MB IDE Conner CP-3204 hard disk has an internal 64K buffer and is coupled with a Promise Technology DC-2032 IDE pass-through controller that also holds 1MB of cache. A Quickpath Systems Cyclone XG Windows Accelerator sits in the video slot and carries the expected S3



The \$2,675 Dataworld Data 486/DX2-50

GUI accelerator and 1MB of video RAM. A 14-inch ViewSonic 5E monitor is rated up to 1,024-by-768 resolution at a 72-Hz refresh rate, but you can opt for ViewSonic's higher-end products.

Performance was mixed. The ViewSonic 5E monitor had a defect, and it generated poor images that no amount of control-twiddling could appease. The Cy-

FACT FILE

Dataworld Data 486/DX2-50

Dataworld Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660; 800-274-2983, 310-695-3777; fax, 310-695-7016

List Price (Tested Configuration): \$2,675.

Memory and processor RAM cache: 4MB 60-ns. SIMMs, 64K cache.

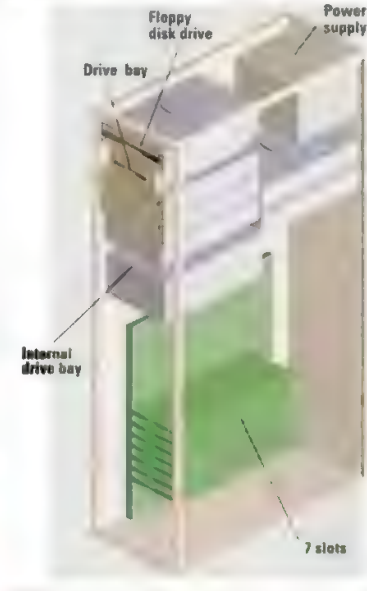
Disk drives and controller: Conner 19-ms. 212MB IDE hard disk, Promise Technology controller with 1MB RAM, 1.2MB and 1.44MB floppy disk drives.

Display: Quickpath 1,280-by-1,024 Windows accelerator with 1MB RAM, ViewSonic 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: Inconsistent performance and some design weaknesses prevent Dataworld's moderately priced ISA tower from standing out.

ON READER SERVICE CARD



clone card, however, delivered typically respectable Windows graphics and a mediocre DOS-based video score because of its S3 chip set. The 19-millisecond Conner CP3204 hard disk did well, placing in the top 15 on our disk test. Its processor and memory scores were weak, not only because of the small secondary RAM cache size, but also because this system will not run at zero wait states: We had to implement two read and three write wait states.

Dataworld distributes its system directly and includes a one-year parts-and-labor warranty, free on-site service, and toll-free technical support, along with generally thorough documentation.—OR

Deico Electronics Inc.

Deico Predator 486DX2/50

The centerpiece of the \$3,135 Deico Predator 486DX2/50's arrangement is an ISA-based Predator I motherboard that can be outfitted with a selection of 386 or



The \$3,135 Deico Predator 486DX2/50

486 SX, DX, and DX2 processors. This unit was one of the best performers on our processor and memory tests. Not surprisingly, the company markets this PC as a product in itself. With its ability to maintain high performance across processor classes and manufacturers (AMD, Chips & Technologies, and Intel), the Predator I motherboard adds unique value to the Deico system.

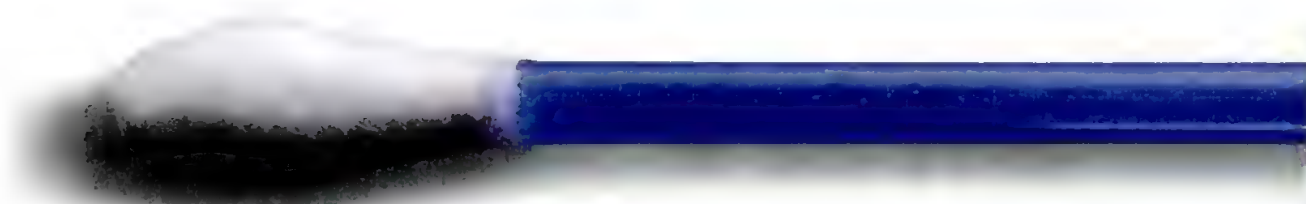
The Deico's mini-AT system board holds a maximum of 64MB of RAM. You can order it in any one of five cases, from a one-drive midget chassis to a full-tower configuration. In all other ways, this DX2 is like the other 16-bit ISA machines in our roundup. Our test unit came with 4MB of RAM, a 256K processor RAM cache, and a 200MB Western Digital Caviar hard disk with a 64K buffer in a small-footprint case. Deico ships the unit with a ViewSonic 14-inch monitor connected to a Boca Research 1,024-by-768 video adapter with 1MB of RAM.

Each system, in whatever chassis you choose, comes with one of three hard disk sizes: 80MB, 120MB, and 200MB, with 200MB models from Western Digital (the tested hard disk), Conner, or Quantum. There are no display or video card options, just memory, cache, and VRAM upgrades. But for the price of this system, you do get one performance measure that takes it well beyond the ordinary.

The Deico placed among the top five

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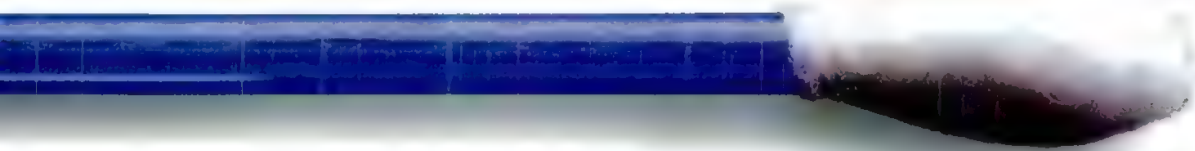
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drive bays*



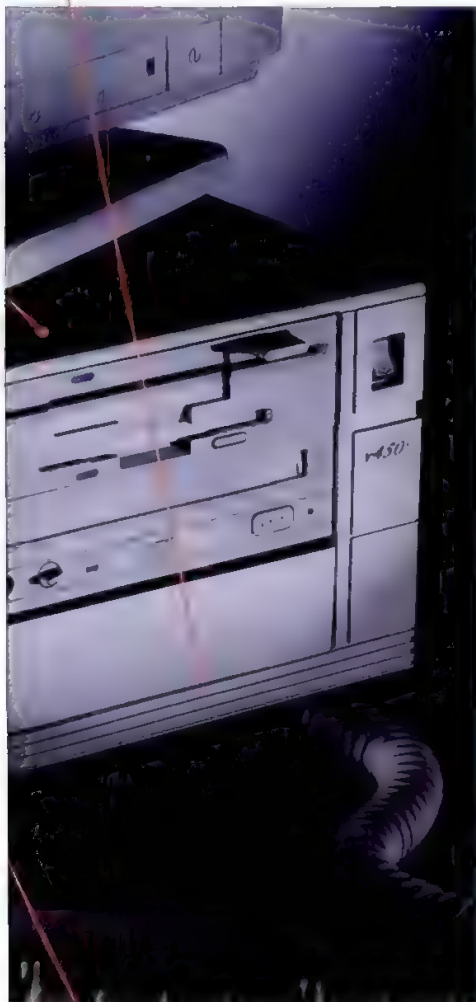
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FACT FILE

Deico Predator 486DX2/50

Deico Electronics Inc., 2800 Bayview Dr.,
Fremont, CA 94538; 800-321-8990,
510-651-7800; fax, 510-651-6109

List Price (Tested Configuration): \$3,135.

Memory and processor RAM cache: 4MB 80-ns.
SIMMs, 256K cache.

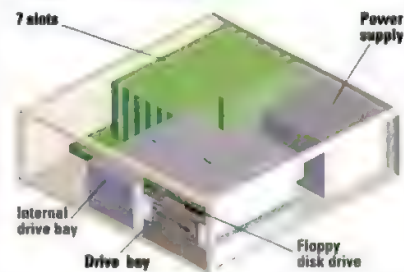
Disk drives and controller: Western Digital 14-ms.
200MB IDE hard disk, VLSI controller, 64K cache, 1.2MB
and 1.44MB floppy disk drives.

Display: Boca 1,024-by-768 adapter with 1MB RAM,
ViewSonic 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The Deico Predator 486DX2/50 is notable for
the upgrade flexibility of its motherboard design plus its
good CPU/memory performance. Limited options make
this a platform for do-it-yourself expansion.

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systems on our processor and memory
tests; a 256K direct-mapped processor
RAM cache and a Symphony SL82C465
cache controller helped it achieve these
excellent scores. The system's Boca Re-
search SVGAN1 video adapter with an
NCR 77C22E vid-
eo chip set per-
formed well on our
DOS-based video
test but was among
the slower systems
on our Graphics
Winmark test. The
Western Digital
Caviar 2200 IDE
hard disk produced
average times.

The Deico's se-
lection of options
and features is too limited for running ap-
plications other than DOS programs.
However, its processor upgrade flexibility
makes it an interesting consideration if
you're inclined to equip it with the periph-
erals you need.



The \$3,018 Dell System 486D/50

Deico warrants its systems for two
years on parts and labor for the
motherboard and for one year for all
other components. On-site service from
Integrated Automation International
(IAI) costs \$75 for the first year; ex-
tended warranties are available up to five
years. Technical support is available
weekdays.—GP

Dell Computer Corp.

Dell System 486D/50

The Dell System 486D/50 sells for \$3,018
with 4MB of RAM and a 240MB Quan-
tum IDE hard disk with a 256K disk
cache. This small-footprint ISA-bus desk-
top is obviously well designed and built.
Without a secondary RAM cache, the
Dell is no stellar performer for this group
of computers, but it holds its own. Given
the company's aggressive pricing and in-
creased commitment to user support, this
machine is a good buy.

The Dell's motherboard incorporates
a VLSI chip set and a custom Phoenix/
Dell ROM BIOS. The lack of a processor
RAM cache compromises this PC's per-
formance somewhat, but you can equip
the machine with up to 64MB of RAM as
well as upgrade the main processor. A
Western Digital 1,024-by-768 video chip
set is built into the motherboard, saving
an expansion slot.

The Dell's benchmark test scores were
generally fair to low, except for the DOS-
based video and disk scores. The Western

Digital video chip
delivers a high DOS
video score but re-
latively low per-
formance under Win-
dows. The 16-mil-
lisecond 240MB
Quantum LPS240
hard disk, seen on
many of the tested
systems, performs
respectably.

The Dell's pack-
aging is classy and
complete, from the shipping materials to
the documentation to the hardware. The
case cover is easy to remove via three fin-
ger screws—helpful if you want to add a
peripheral card to one of the six ISA slots
or change hard disks. The small case has

five drive bays: two for internal 3.5-inch
devices and the others for accessible 5.25-
inch drives.

Dell computers are sold directly,
through consumer channels and com-
puter superstores, and through VARs. The
service and support mix includes a one-
year parts-and-labor warranty with on-
site service via BancTec Service Corp.
Toll-free technical support is available
seven days a week.—BB

FACT FILE

Dell System 486D/50

Dell Computer Corp., 9505 Arboretum
Blvd., Austin, TX 78759-7299; 800-289-
3355, 512-338-4400; fax, 512-338-8700

List Price (Tested Configuration): \$3,018.

Memory and processor RAM cache: 4MB 80-ns.
SIMMs.

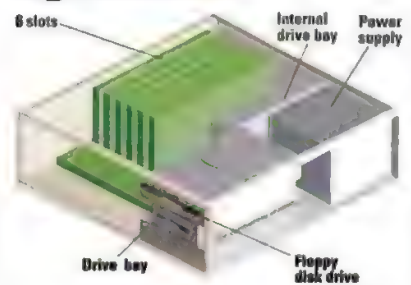
Disk drives and controller: Quantum 16-ms. 240MB
IDE hard disk, 256K cache, 1.2MB and 1.44MB floppy
disk drives.

Display: Western Digital 1024-by-768 local video with
1MB RAM, Dell 14-inch monitor, 70-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The Dell System 486D/50 is a good choice if
you want a well-built, small-footprint machine and can
accept reasonable performance with limited drive ex-
pansion space.

ON READER SERVICE CARD



Diamond Technologies Inc.

DT 486DX2/50

Though its name implies a special sparkle,
the \$2,199 Diamond DT 486DX2/50
doesn't shine any brighter than its peers.

The mini-tower case, difficult to open,
contains four front-accessible drive bays
and one internal bay; a 200-watt power
supply with five connectors; and front-
mounted power, turbo, and reset switches.
For some reason, Diamond installed its
5.25-inch Y-E Data floppy disk drive in

FACT FILE

DT 486DX2/50

Diamond Technologies Inc., 17155 Von Karman Ave., #103, Irvine, CA 92714; 800-989-7253, 714-252-1008; fax, 714-252-1508

List Price (Tested Configuration): \$2,199.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache.

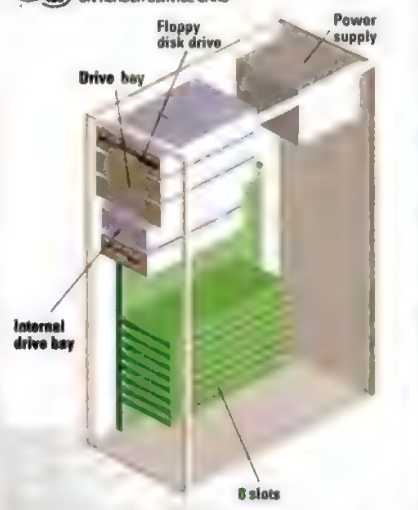
Disk drives and controller: Western Digital 14-ms. 202MB hard disk, OPTi controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB RAM, CTX 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: A very competitive price highlights the rather nondescript DT 486DX2/50.

ON READER SERVICE CARD



memory test results were entrenched in midpack, and the Western Digital hard disk landed on a bottom rung. The Diamond SpeedSTAR's Tseng ET4000 performed as expected: well on conventional DOS graphics and poor under Windows.

Diamond sells the DT 486DX2/50 only directly but adds a two-year labor and 15-month parts warranty, along with optional on-site service (\$75). You can reach toll-free tech support during business hours, Pacific time.—OR

Digital Equipment Corp.

DECpc 452ST

The \$8,850 DECpc 452ST makes a valiant attempt at reliability but fails to provide performance that warrants its price. Yet before you choke on the system price, un-



The \$8,850 DECpc 452ST

derstand that DEC overloaded the system it sent to PC Magazine Labs with 32MB of RAM and an 852MB hard disk.

The DECpc is based around an Intel EISA motherboard using Intel's new Xpress architecture. Xpress provides specially designed ASICs to manage an asynchronous interface between the memory BIOS—where the CPU module, system memory, and the secondary cache reside—and the EISA bus. The 32MB of system RAM (expandable to 64MB on-board or 192MB with the proprietary add-in card) is backed by a somewhat-lacking 64K look-aside, two-way, set-associative, write-through processor RAM cache. The Digital PCXAR-AC 852MB SCSI-2 hard disk is connected to an Adaptec 1740A cacheless EISA SCSI controller; 52MB, 105MB, 209MB, and 420MB hard disks are also offered.

DEC's choice of video included a 1MB Tandy PCX46-AC ISA video adapter and a 14-inch Tandy PC4XV-B2 multi-scanning monitor capable of a 72-Hz refresh rate at 1,024-by-768 resolution (a higher-end PCX46-4D adapter and a 20-inch monitor are also available).

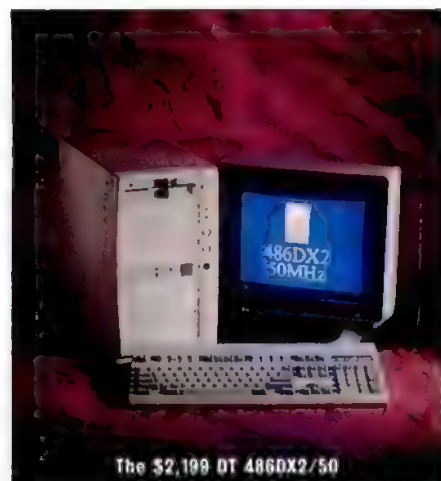
The sturdy standard tower case provides four front-accessible 5.25-inch drive bays and one internal 3.5-inch bay next to the 250-watt, six-connector power supply. Power, reset, and turbo switches are all front-mounted. The included software and documentation were very complete and well presented.

Despite Intel's Xpress architecture and Turbocache chip set, the system's processor and memory scores didn't stand out very much, though they were better than those of other systems using only a 64K secondary cache. The noncaching

the topmost bay and its 3.5-inch Y-E data floppy disk drive in the bottom bay—a quirky arrangement, but it did not affect performance.

The Dash motherboard has a socket-upgradable AMI BIOS, an OPTi chip set, a Weitek math coprocessor socket, and eight ISA slots; the last one is extended. The memory is easily accessible, but the processor is buried behind a portion of the drive bay assembly. Also, the location of the SIMM chips—directly behind four of the expansion slots—prevents those slots from accepting full-length cards. There was one measure of forethought in this uninspired design: Diamond placed its I/O card in the last available slot and thus avoided running I/O cables over other expansion slots.

The Diamond comes with 4MB of RAM (32MB maximum on the system board), backed by a 256K 20-nanosecond SRAM look-through direct-mapped write-back processor RAM cache. Also included is a Western Digital Caviar WDAC-2200 202MB IDE hard disk with a 64K buffer and an OPTi IDE hard disk controller card. Video is based on a 1MB



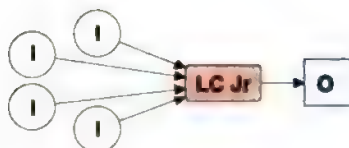
The \$2,199 DT 486DX2/50

Diamond SpeedSTAR, another Tseng ET4000 adapter. The 14-inch CTX 5468 Super VGA monitor is capable of 800-by-600 resolution. All of its controls, which are analog, are front-mounted; image controls were limited to horizontal and vertical position tuners and one vertical sizing dial. Documentation was sparse, dominated by the SpeedSTAR's manual and some laconic system board pages.

Though the Diamond failed to distinguish itself in performance, its scores weren't the worst. But even with its 256K processor RAM cache, processor and

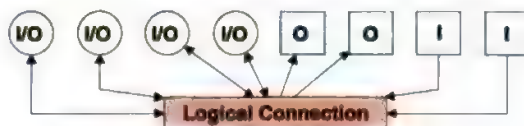
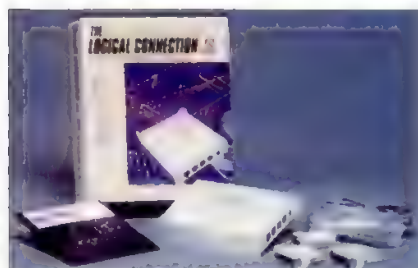
Printer Sharing

- PARALLEL DEVICE - SERIAL DEVICE - PARALLEL OR SERIAL DEVICE I = INPUT FROM PC O = OUTPUT TO PERIPHERAL



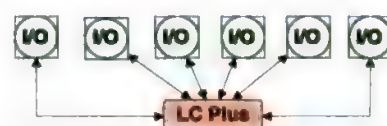
LC Jr.-256Kb \$239

Serially connect up to four PCs to the **Logical Connection Jr.** at speeds up to 115,200 bps. It will automatically convert the data for easy sharing of one parallel printer.



LC-512Kb \$495

The **Logical Connection** has eight ports: four bi-directional serial ports which can be set as input or output, two parallel inputs and two parallel outputs.



LC Plus-512Kb \$695

All six ports of the **Logical Connection Plus** are automatically configured as parallel or serial, and input or output. Versatility and high speed are key features.



- UL Listed Power Supplies
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Logical Connections allow several users to easily share expensive printers and other resources. Choose the peripheral that you need with a pop-up menu or ASCII string.

Multiple users can send data simultaneously since Logical Connections with memory will buffer and queue jobs on a first-in-first-out basis. A 256Kb buffer will hold up to 100 pages of text or about 5 - 10 pages of graphics data.

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Logical Connection, Inc.

4660 Portland Road NE #108, Salem, OR 97305

FAX: (503) 390-9372

Tech. Support: (503) 390-9375

LOGICAL CONNECTION 800-238-9415 US & Can.

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Toshiba Laptop Models:

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2000SX, 2200SX (exclude 1Mb)

Memory Card	RCT-1000	1 Mb	CALL
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Memory Card	RCT-4000	4 Mb	CALL
Memory Card	RCT-8000	8 Mb	CALL

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For Laptops conforming to this new universal spec.

Memory Card	RJB-0512	512 Kb	CALL
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Memory Card	RJB-2000	2 Mb	CALL

FACT FILE

DECpc 452ST

Digital Equipment Corp., 146 Main St.,
Maynard, MA 01754; 800-722-9332;
fax, 508-486-6422

List Price (Tested Configuration): \$8,850.

Memory and processor RAM cache: 32MB 80-ns. SIMMs, 64K cache.

Disk drives and controller: Digital 9.5-ms. 852MB SCSI hard disk, Adaptec controller, 1.2MB and 1.44MB floppy disk drives.

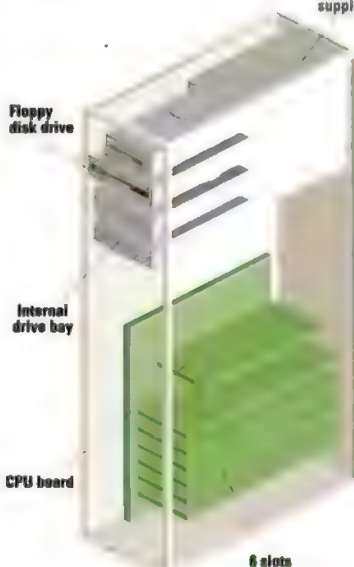
Display: Tandy 1,024-by-768 adapter with 1MB RAM, Tandy 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: Massive amounts of RAM and hard disk storage do little to boost the performance of the DECpc 452ST.

ON READER SERVICE CARD

Power supply



SCSI controller offset the 9-millisecond rating of Digital's hard disk to yield midrange performance, but the Tandy video system was disappointing under both Windows and DOS.

DEC sells the DECpc 450ST directly or through distributors, with a one-year parts-and-labor warranty, free on-site service, and toll-free technical support during business hours, Eastern time—OR

Edge Technology Inc.

Edge 486 DX2-50

The \$2,899 Edge 486 DX2-50 could easily fall under the category of "Faceless Aver-

age Systems," but it does manage to stand out slightly from the other 62 contenders in this crowd by including a solid video system.

The video subsystem is comprised of a PortaCom Technologies Eclipse adapter carrying an S3 video accelerator and 1MB of video RAM; you can also get a Trident 8900C adapter. The monitor is even better: a 15-inch MAG MX15H with front-mounted digital controls and a digital LED mode indicator, capable of 65,000 colors and able to hit 1,280-by-1,024 resolution at a 60-Hz refresh rate and 1,024-by-768 resolution at a flicker-free 72 Hz.

Though the rest of the system didn't shine as brightly, to Edge's credit, it certainly remained dignified. The standard small-footprint desktop case contains

FACT FILE

Edge 486 DX2-50

Edge Technology Inc., 915 E. Karcher Rd.,
Nampa, ID 83687; 800-438-3343,
208-465-3434; fax, 208-465-3424

List Price (Tested Configuration): \$2,899.

Memory and processor RAM cache: 8MB 70-ns. SIMMs, 256K cache.

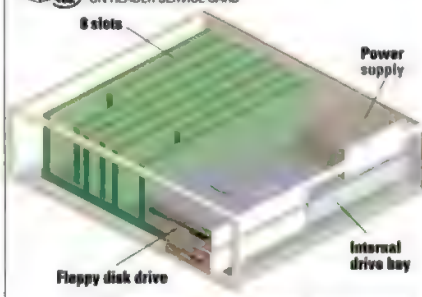
Disk drives and controller: Quantum 16-ms. 240MB IDE hard disk, ECS controller, 1.2MB and 1.44MB TEAC floppy disk drives.

Display: Portacom 1,280-by-1,024 adapter with 1MB RAM, MAG 15-inch monitor, 72-Hz refresh rate at 1,024-by-768.

Software: DOS 5.0.

In Short: Edge offers accelerated Windows performance with a wonderful MAG monitor at an attractive price.

ON READER SERVICE CARD



three 5.25-inch half-height front-accessible drive bays and one 3.5-inch internal bay placed beneath the 200-watt, seven-connector power supply.

The ECS motherboard contained eight ISA slots, one of which is reserved for proprietary memory expansion that allows the usual 4MB of RAM to reach 64MB (32MB is the maximum on-board). There's also a fast 15-nano-second 256K look-through, direct-mapped, write-back processor RAM

cache; a 240MB IDE Quantum ProDrive LPS 240 hard disk with a 256K buffer (Maxtor 340MB, 675MB, and 1027MB hard disks available); and a cacheless ECS CI-90 IDE pass-through controller.

Video performance was fast under Windows (as expected), and not so fast under DOS (also as expected). Processor, memory, and disk performance all reflected the high-quality components that combined to perform competitively, though not exceptionally.

Edge unfortunately sells the 486 DX2-50 only directly but includes the typical one-year parts-and-labor warranty, free on-site service, and toll-free technical support.—OR

Eltech Research Inc.

Eltech Model 4500 DX2

The \$1,999 Eltech Model 4500 DX2 is a classic example of an average machine: A small desktop PC slapped together entirely out of off-the-shelf components, supplying reasonable performance.

The standard small-footprint desktop case is slightly smaller than normal. It contained a typical 200-watt power supply with four connectors and five front-accessible bays: three 5.25-inch half-heights and two vertically mounted 3.5-inch half-heights. The case showed some age, since its power switch was rear-mounted, though the reset and turbo switches are conveniently up front.

The Eltech's own motherboard was no design winner, either. Though the Intel



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QIC 40 Read	•	•	
Irwin 80 & 40 Read	•		•
Windows 3.1 & DOS software	•		
Fits standard 1" bay	•		
QIC 80 entry price	\$299	\$350	\$349

only one optimized specifically for Windows 3.1. It even includes

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IT ALSO SAID DISCO AND COMMUNISM WERE HERE TO STAY.

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4 MB RAM, 120 MB Hard Drive, Dual Floppy Drives (3.5"
and 5.25"), Ultra VGA 1024NI Monitor (14", 1024 x 768,
.28mm), MS-DOS® 5.0/Microsoft® Windows® 3.1/Mouse

DIMENSION 486DX/33

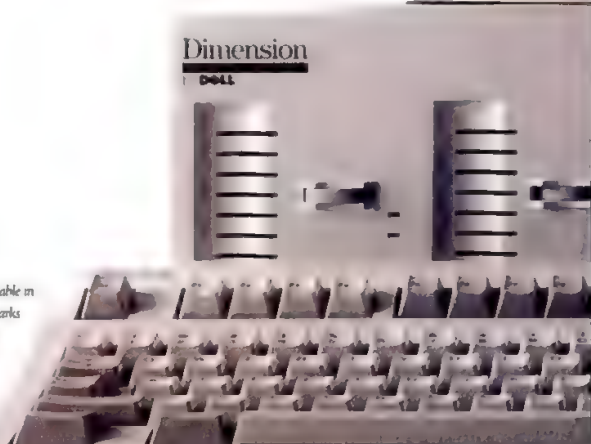
\$2,299

Lease: \$85/MO.

i486DX 33 MHz System
4 MB RAM, 212 MB Hard Drive, Dual Floppy Drives (3.5"
and 5.25"), Ultra VGA 1024NI Monitor (14", 1024 x 768,
.28mm), MS-DOS 5.0/Microsoft Windows 3.1/Mouse



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\$2,199

Lease: \$81/MO.

DIMENSION 486SX/25s i486SX 25 MHz System
4 MB RAM, 212 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Ultra VGA 1024NI Monitor (14", 1024 x 768, .28mm), MS-DOS 5.0/Microsoft Windows 3.1/Mouse

\$2,699

Lease: \$100/MO.

DIMENSION 486DX/33s i486DX 33 MHz System
8 MB RAM, 212 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Ultra VGA 1024NI Monitor (14", 1024 x 768, .28mm), MS-DOS 5.0/Microsoft Windows 3.1/Mouse

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Lease: \$55/MO.

DIMENSION NL20 i386SL 20 MHz System*
2 MB RAM, 40 MB Hard Drive, Weight: 6.3 lbs. including battery, Minimum battery life: 2.5 hours, Edgelit VGA LCD (8.5" Diagonal, 640 x 480), MS-DOS 5.0/Microsoft Windows 3.1/Mouse

\$1,799

Lease: \$67/MO.

DIMENSION NL25
i386SL 25 MHz System*
2 MB RAM, 60 MB Hard Drive.
Weight: 6.3 lbs. including battery
Minimum battery life: 2.5 hours
Edgelit VGA LCD (9.5" Diagonal,
640 x 480), MS-DOS 5.0/
Microsoft Windows 3.1/Mouse

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Lease: \$50/MO.

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\$1,549

Lease: \$57/MO.

DIMENSION 386DX/33 i386DX 33 MHz System
4 MB RAM, 80 MB Hard Drive, Dual Floppy Drives (3.5" and 5.25"), Super VGA 1024I Monitor (14", 1024 x 768, .28mm), MS-DOS 5.0/Microsoft Windows 3.1/Mouse

Dimension
by **DELL**

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HOURS: 7AM-7PM CT MON-FRI, 8AM-4PM CT SAT.

WHEN CALLING, PLEASE REFERENCE #11BX8.

CIRCLE 033 ON READER SERVICE CARD

DX2/50 processor was located almost diametrically to the system's single fan, it lacked a heat sink. Also, it was buried underneath two of the drive bays, where it was joined by the Weitek math



The \$1,999 Eltech Model 4500 DX2

coprocessor socket. The SIMM banks, concealed behind a large clump of cables, were only slightly easier to get to. The board held seven ISA slots, one proprietary extended expansion slot, and used a socket-upgradable AMI BIOS.

The Eltech arrives with 4MB RAM

FACT FILE

Eltech Model 4500 DX2

Eltech Research Inc., 47266 Benicia St.,
Fremont, CA 94538; 800-358-8330,
510-438-0990; fax, 510-438-0663

List Price (Tested Configuration): \$1,999.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 128K cache.

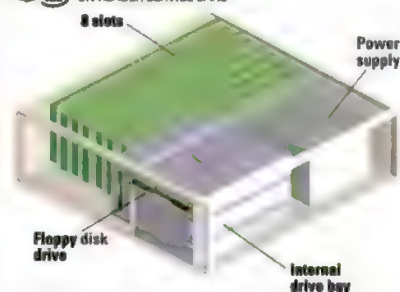
Disk drives and controller: Western Digital 15-ms. 202MB IDE hard disk, Promise Technology controller, 512K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB RAM, MGC 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1, Microsoft Works for Windows.

In Short: The Eltech Model 4500 DX2 offers reasonable performance in a piecemeal system of standard industry components.

ON READER SERVICE CARD



(32MB maximum); 128K of 20-nanosecond direct-mapped write-back cache RAM; and a familiar 202MB IDE Western Digital WDA-2200 Caviar hard disk connected to a Promise Technology DC2031 IDE pass-through adapter with a 512K cache (540MB Conner and 400MB Seagate hard disks are also available).

Video consisted of a Diamond SpeedSTAR video card with 1MB of video DRAM (Diamond Stealth or Orchid Fahrenheit boards are also available) and a 14-inch MGC Super VGA monitor capable of a 60-Hz refresh rate at 1,024-by-768 resolution. The MGC monitor was below par: flimsy, and only the power and brightness/contrast controls were front-mounted. System documentation was neatly presented but a little sparse, though it included the *Concise Guide to Microsoft Windows*.

Processor and memory benchmark test scores were competitive, reflecting the 128K secondary cache. The hard disk with its 512K cache also performed respectably, while the SpeedSTAR's Tseng ET4000 chip set did well under DOS and not as well under Windows, as expected.

Eltech sells the unit directly and through dealers, and offers a one-year parts-and-labor warranty, free on-site service, and toll-free tech support during business hours, Pacific time.—OR

EPS Technologies Inc.

EPS 486-50DX EISA

The sturdy EPS 486-50DX EISA tower stands out for its strong construction and easy-access cache, peripherals, and memory upgrade slots. The secure tower



The \$2,995 EPS 486-50DX EISA

FACT FILE

EPS 486-50DX EISA

EPS Technologies Inc., 10069 Dakota Ave.,
P.O. Box 278, Jefferson, SD 57038; 800-447-
0921, 605-966-5586; fax, 605-966-5482

List Price (Tested Configuration): \$2,995.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 128K cache.

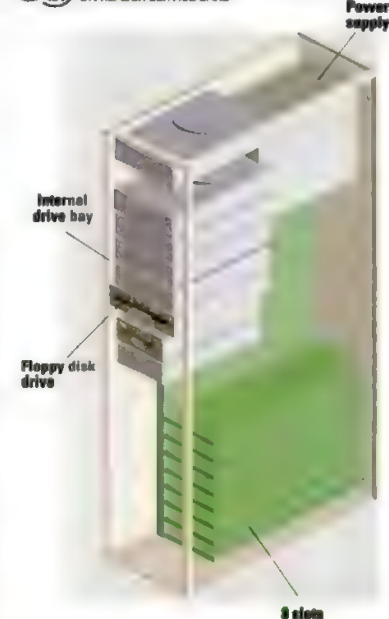
Disk drives and controller: Maxtor 15-ms. 212MB SCSI hard disk, DTC controller, 512K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Cardinal 1,024-by-768 adapter with 1MB RAM, AOC 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: This tower PC performed well on our benchmark tests, supports EISA, and has good expansion; yet it costs the same as many of the small-footprint desktop PCs in this roundup.

ON READER SERVICE CARD



design gives you an expansive platform for loading processor-hungry applications and add-ins at a price that is competitive with small-footprint 50-MHz DX2s.

In its standard configuration, the EPS costs \$2,995 with 4MB of RAM, 128K of direct-mapped processor RAM cache with an Anigma cache controller, and a 212MB Maxtor SCSI hard disk with a DTC controller that runs a 512K disk cache. The Super VGA display includes a multiscanning 14-inch AOC monitor controlled by a Cardinal video adapter. The EPS has eight EISA slots (none proprietary); five were empty in our test system.

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Drive bays consist of four 5.25-inch half-heights and two 3.5-inch slimlines for removable media; two more 5.25-inch half-heights are internal.

With a little mix and match from EPS's short selection of options, it's possible to drop the system price to even more aggressive levels. A switch to an ISA-based system design can knock off \$700, and a straight downgrade to the 130MB Maxtor IDE hard disk subtracts \$450. EPS offers 15- and 16-inch display options for an extra \$125 and \$175. Though you can up your system's performance by adding some higher-end options, the standard system configuration is a midrange performer.

This EISA-based system uses a 15-millisecond Maxtor 213S SCSI hard disk that placed twelfth among all the systems tested in this review. Its DTC 3290S controller ran our tests with a 512K cache installed but may be upgraded to 4MB. The system's Cardinal 765 video adapter, based on the Tseng ET4000 chip set, performed better on our DOS-based video test, where it came in seventh, but yielded a low Windows score. Processor and memory scores were midrange.

EPS Technologies' standard warranty includes a 60-day money-back guarantee and one-year coverage on parts and labor. Free first-year on-site service is from Idea Servcom, with extensions based on system price. A toll-free line handles calls for technical support and service weekdays and Saturdays.—GP

Epson America Inc.

Epson Equity 486DX2/50 Plus

Epson is a big name in printers, and justifiably so. But to maintain its excellent reputation in the desktop PC market, the company will have to do better than the solid construction but second-tier performance of its \$2,599 Equity 486DX2/50 Plus.

A solid desktop case holding a 200-watt power supply with five connectors,

three front-accessible drive bays, and two internal drive bays surrounds an Epson motherboard with six ISA slots. Memory and processor modules are accessible and do not interfere with any expansion slots.

The processor is covered by a heat sink.

Epson's motherboard holds 4MB of RAM (16MB system maximum) and an Intel A82385 cache controller with a 32K two-way set-associative, buffered write-through processor RAM cache. Integrated

onto the motherboard is a 212MB IDE Conner CP3204F hard disk, 3.5- and 5.25-inch floppy disk drives, video circuitry (1MB of video RAM), and all the I/O: one serial port, one parallel port, a mouse port, and a keyboard. The 14-inch Epson



FACT FILE

Epson Equity 486DX2/50 Plus

Epson America Inc., 20770 Madrona Ave.,
Torrance, CA 90503; 800-922-8911,
310-782-0770; fax, 310-782-5220

List Price (Tested Configuration): \$2,599.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 32K cache.

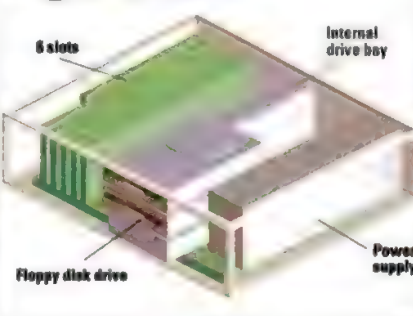
Disk drives and controller: Quantum 16-ms. 240MB IDE hard disk, 1.2MB floppy disk drive.

Display: 1,024-by-768 adapter integrated on motherboard (not local bus) with 1MB RAM, Epson 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1, Bitstream FaceLift for Microsoft Windows.

In Short: Epson America has built a solidly constructed system at a competitive price, but its performance is disappointing.

ON READER SERVICE CARD



Extended VGA Color Monitor is capable of up to 1,024-by-768 resolution at 60 Hz, but isn't nearly as well put together as Epson's new Professional Series monitors. A typical 101-key keyboard, Windows 3.1, and Bitstream Facelift for Windows are also included.

Performance is where the Equity falls far short. Except for a respectable DOS-based video score, all other numbers were in the dumper. Windows graphics performance was poor, and the 32K processor RAM cache, leading to bottom-echelon processor and memory results, just wasn't enough. Even the integrated Conner hard disk failed to achieve average scores, bringing the quality of its controller chip set into question.

Epson sells the Equity directly or through dealers and adds a one-year parts-and-labor warranty, free on-site service, and toll-free technical support.—OR

Everex Systems Inc.

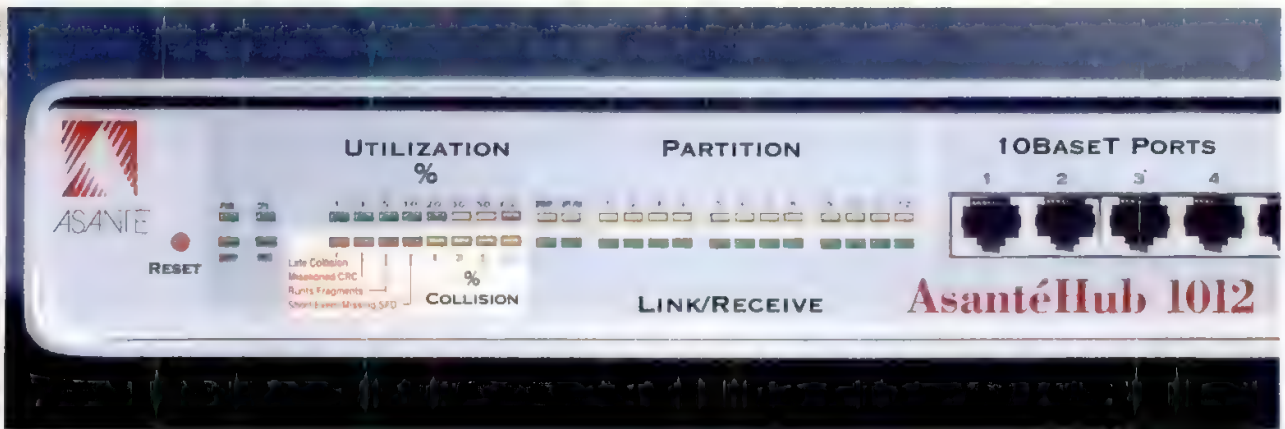
Everex STEP 486DX2/50E

The Everex STEP 486DX2/50E is a potentially substantial machine wrapped in a standard desktop package. The design is not as polished as Compaq's Deskpro/M series, but in many ways, they are two of a kind. Both result from high-quality manufacturing that emphasizes integrating each company's own label components and system designs.

As with the Compaqs, such devotion to quality inevitably leads to higher costs. The Everex's \$6,242 price tag buys a six-



slot EISA system with 4MB of RAM on a proprietary memory card, 256K of processor RAM cache, and a 212MB Seagate hard disk with an Everex hard disk controller, but this price is too high to justify.



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punch-down block connections.

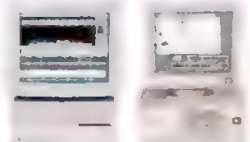
There is also a 3-in-1 "13th" port for interconnecting multiple hubs with backbone cabling. This port includes BNC, RJ-45 and AUI connectors supporting a variety of cabling media.

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NEC

FACT FILE

Everex STEP 486DX2/50E

Everex Systems Inc., 48431 Milmont Dr.,
Fremont, CA 94538; 800-992-3839,
510-498-1111

List Price (Tested Configuration): \$6,242.

Memory and processor RAM cache: 4MB 70-ns.
SIMMs, 256K cache.

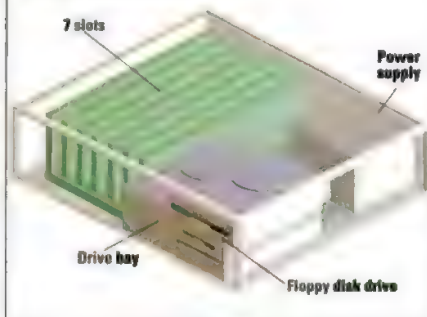
Disk drives and controller: Seagate 15-ms. 212MB
IDE hard disk, Everex controller, 1.2MB and 1.44MB
floppy disk drives.

Display: Everex 1,024-by-768 adapter with 1MB RAM,
CTX 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The Everex STEP 486DX2/50E's quality con-
struction parallels that of the Compaq Deskpro 50M, but
its price and performance are not competitive.

ON READER SERVICE CARD



The display subsystem in our test unit was built around the ViewPoint Premium 1,024-by-768 adapter with 512K of video RAM. However, the 14-inch CTX monitor can manage only 800-by-600 noninterlaced resolution with a 60-Hz refresh rate.

The Everex STEP line of computers comes with a list of powerful and expensive expansion options. System memory tops out at 64MB on the proprietary card, and the selection of Seagate hard disks ranges from the \$444 89MB disk to the \$3,199 1GB hard disk. The list also includes the \$2,299 535MB Maxtor LXT. Display options include 15-, 17-, and 21-inch EverVision monitors ranging in price from \$849 to \$3,499. Everything is cov-

ered by Everex's solid service and support program for the STEP series.

Despite the presence of a 256K direct-mapped processor RAM cache, there was nothing extraordinary about this EISA system's performance on our processor or memory tests. The Seagate ST-1239A 212MB IDE disk and Tseng-based video adapter turned in results typical for these components. The video card requires 1MB of video RAM to display Windows at 800-by-600 resolution with 256 colors, so we had to add an additional 512K to run our tests. As seen before, the Tseng ET4000 chip set performs better under DOS than under Windows.

Everex supports its STEP systems with a one-year warranty on parts and labor and offers extended and out-of-warranty programs at prices based on system configuration. Pricing for on-site service from National Computer Systems varies as well. Everex's technical support and service lines are open weekdays.—GP

FutureTech Systems Inc.

FutureTech System 452E

If you need a high-performance file server with loads of drive expansion space, here's one just for you. The FutureTech System 452E lists for \$4,629 with 4MB of RAM and a 340MB hard disk with caching disk controller. This system kicks disks and takes names.

The FutureTech's Mylex motherboard with Mylex ROM BIOS, Intel chip set, and Intel cache controller, has a 128K 20-nanosecond write-back processor RAM cache. Maximum RAM is 96MB, with 32MB on the motherboard and 64MB on a memory expansion card. The test unit's video subsystem consisted of a Diamond Computer

Stealth VGA 1,024-by-768 adapter with 1MB of RAM and a REDMS 14-inch monitor with a modest 60-Hz refresh rate.

The Fujitsu 12-millisecond 340MB SCSI-2 hard disk has its own 256K read-

FACT FILE

FutureTech System 452E

FutureTech Systems Inc., Six Bridge St.,
Hackensack, NJ 07601; 800-275-4414,
201-488-4414; fax, 201-488-4405

List Price (Tested Configuration): \$4,629.

Memory and processor RAM cache: 4MB 70-ns.
SIMMs, 128K cache.

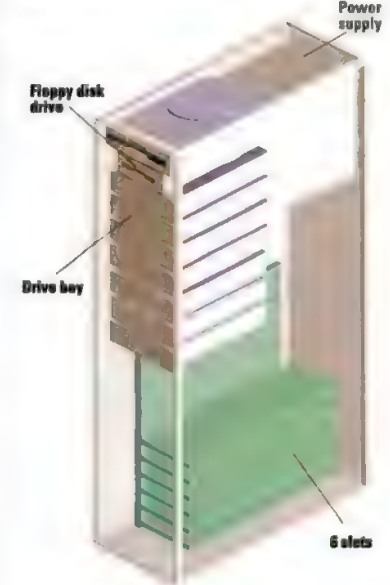
Disk drives and controller: Fujitsu 12-ms. 340MB
SCSI hard disk, AMI controller, 4MB cache, 1.2MB and
1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB
RAM, REDMS 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: FutureTech Systems' roomy EISA tower is all
set to handle nine hard disks. It costs a bit more but has
great disk performance.

ON READER SERVICE CARD



ahead cache buffer. Coupled with the American Megatrends 32-bit EISA hard disk controller and a 4MB disk cache, the Fujitsu hard disk propelled the system to a third-place score on our disk test. The FutureTech also did well on the memory and processor tests, where it ranked tenth and eighteenth, respectively. Its S3-based Diamond Stealth card allowed good graphics performance under Windows, where it gained a twelfth-place score, but turned in a typically low DOS-based video score. However, if you need fast disk performance for a server or for killer graphics applications, this is the machine to beat.

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March, 1992

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Sept., 1991

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- Infoworld
April, 1992

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The FutureTech's huge tower case on casters has nine drive bays: five for removable 5.25-inch media and four for internal 3.5-inch drives, one of which can be used as a full-height drive. From the dual cooling fans to the front door that covers the accessible drive bays, this case exemplifies good design and sturdy construction.

Since FutureTech sells via direct sales and VARs, discounts may be possible. The standard parts-and-labor warranty lasts 15 months. An on-site service contract through Computer Technology costs \$79 for one year. FutureTech keeps its toll-free technical support line open during weekday business hours.—BB

GRiD Systems Corp. **GRiD MFP/450**

A unique integrated chassis design and interesting execution of standard PC technology in a well-crafted slimline case distinguish the Tandy-manufactured GRiD MFP/450. Unfortunately, performance and expandability do not.

For \$3,479, you can buy this slimline ISA machine with 4MB of system memory and a 240MB Quantum ProDrive fixed disk with a 256K cache. Though not up to the high-performance graphics demands of Windows, the standard video capabilities for the unit include a Super VGA 1,024-by-768 display subsystem based on a Western Digital adapter with 512K of video RAM and GRiD's own 800-by-600 14-inch monitor.

The flexible but secure plastic case encloses an all-metal chassis that swings up and open, allowing easy access to the system board without requiring you to dismantle or remove major components. The main swing-away chassis section holds all the drives, cabling, and power supply for the GRiD. When the swing-away section is in the up position, there is a clear, unobstructed path to all the plugs and sockets on the motherboard, where you



The \$3,479 GRiD MFP/450

FACT FILE

GRiD MFP/450
GRiD Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94537; 800-222-4743; 510-656-4700

List Price (Tested Configuration): \$3,479.
Memory and processor RAM cache: 4MB 80-ns. SIMMs.
Disk drives and controller: Quantum 16-ms. 240MB IDE hard disk, VLSI controller, 256K cache, 1.2MB and 1.44MB floppy disk drives.
Display: Western Digital 1,024-by-768 adapter with 512K RAM, GRiD 14-inch monitor, 80-Hz refresh rate.
Software: DOS 5.0, Microsoft Windows 3.1.
In Short: The GRiD MFP/450's unique design and selected components are an excellent match for its slimline case but a poor one for the processing power of the 50-MHz DX2.

can upgrade system memory to 32MB or gain access to each of the three 16-bit expansion slots on the vertical backplane plugged into it.

The appeal of the GRiD's design is that you get a big processor in a tightly integrated package, so it's a good corporate network workstation, if expansion is not a concern. What's not appealing is the low 100-watt power supply and limited expansion options. For example, with three bays already taken, internal drive bay space allows only one additional device; the standard monitor displays only VGA resolutions; and there's no support for an external RAM cache.

Our testing drew attention to some of the limitations of the GRiD's system de-

sign. The absence of a processor RAM cache accounted for the near-bottom processor and memory scores of this machine. However, the 15-millisecond Quantum LPS-240AT IDE hard disk with its 256K cache is a consistently good performer. The DOS video performance of the GRiD's Western Digital WD90C30 video chip set put this system in fifth place but led to a disappointing Windows graphics performance.

Even so, the GRiD is a decently designed system backed by Tandy's nationwide service and support network. GRiD offers a one-year warranty on parts and labor, and technical support is toll-free.—GP

Hertz Computer Corp. **Hertz 486/D50X2e**

The Hertz 486/D50X2e ISA-bus desktop comes with 4MB of RAM (32MB maximum) and a Maxtor 15-millisecond 212MB IDE hard disk with a 64K disk cache. The Hertz is not a top performer in



The \$2,790 Hertz 486/D50X2e

this class; it is, however, particularly easy to upgrade to higher-level 486 CPUs. At \$2,790, the Hertz is a reasonably priced 486DX2 computer from an established vendor who sells both directly and through VARs.

Hertz's motherboard uses an AMI ROM BIOS and an ETEQ chip set with an ETEQ cache controller for the 256K direct-mapped write-through cache. The test system came with a 72-Hz 1,024-by-768 noninterlaced monitor and a Diamond Stealth VRAM video card with an S3 video accelerator chip and 1MB of video RAM.

The nicest feature of the Hertz system, beyond its good design, is its ease of CPU

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[†] Specifications for all Leader systems except 486/25 which has 2MB RAM expandable to 16 MB, 16-bit SVGA, 512KB, 3 expansion slots, not upgradable.

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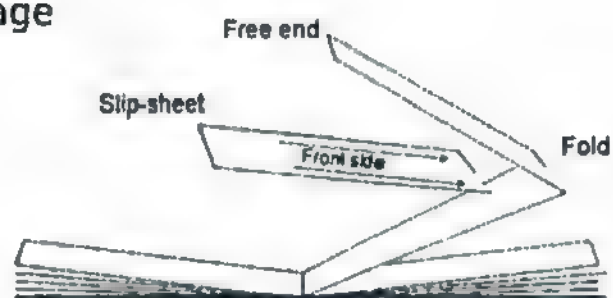
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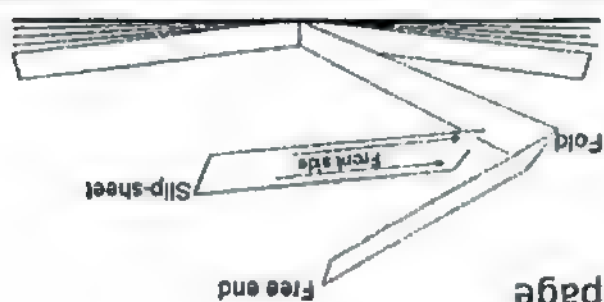
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2. Insert this sheet with
 1. Front side touching the free page
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3. Slice the folded edge
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Foldout slip-sheet



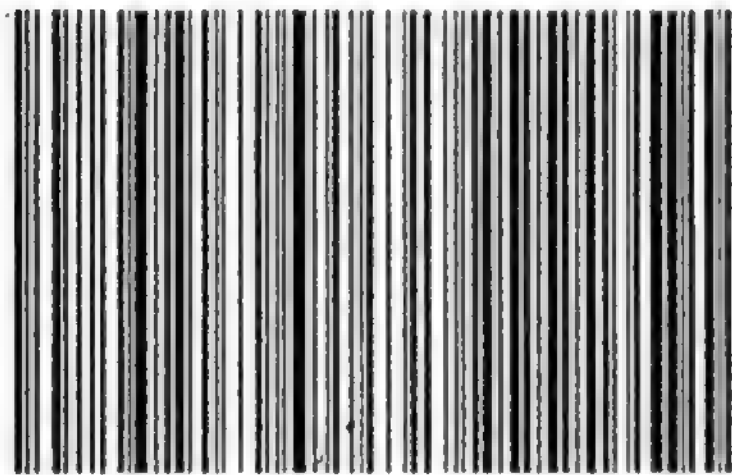
Inverted Foldout slip-sheet



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 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

1. Follow instructions on the other side

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GbsSlpBack-0018

Back

1. Follow instructions on the other side

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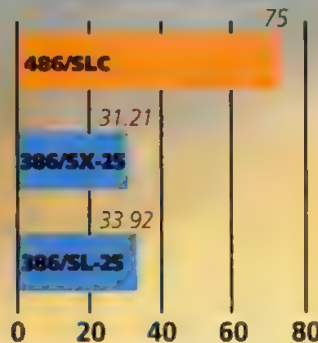
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FACT FILE

Hertz 486/D50X2e

Hertz Computer Corp., 325 Fifth Ave., New York, NY 10016; 212-684-4141; fax 212-684-3658

List Price (Tested Configuration): \$2,790.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache.

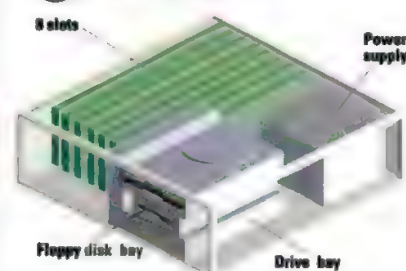
Disk drives and controller: Maxtor 15-ms. 212MB IDE hard disk, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB RAM, Hertz 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: A moderately priced standard performer, the Hertz 486/D50X2e's best feature is its easy CPU upgrade.

ON READER SERVICE CARD



upgrade. Since the motherboard is certified for true 50-MHz DX-50s, theoretically it could take a DX2-100 should such a product become available. To switch CPUs, all you have to do is change the chip and adjust one jumper switch. System drive expansion capacity is adequate but moderate, with three accessible 5.25-inch drive bays and two accessible 1-inch-high 3.5-inch bays. The peripheral card complement includes two 8-bit expansion card slots and six 16-bit slots.

The Hertz system was a midrange performer on our benchmark tests. As usual, the S3 chip-equipped video card turned in better performance on the Graphics Winmark test than on DOS video.

The Hertz's one-year parts-and-labor warranty is backed by a toll-free technical

support number available during weekday business hours only. On-site service is available via Intel or TRW as an extra-cost option, priced depending on system configuration.—BB

HiQuality Systems Inc.

HiQ 43FE

Big is the word that best describes HiQuality's HiQ 43FE. You get all the room and expansion opportunities you would expect in a massive tower design, but at a cost that's \$1,000 more than many of the aggressively priced systems in our review. With another hard disk subsystem, this could be a viable Windows graphics workstation or low-cost file server.

The HiQuality, however, has merits beyond its large frame and cheap plastic faceplate. For \$3,999, you can get an eight-slot EISA-based system with 4MB of RAM, 256K of processor cache, and a 200MB Maxtor SCSI hard disk with an Adaptec controller. In its standard display selection, the company lives up to its name by offering the high-quality NEC MultiSync 3FG 14-inch monitor. A Diamond Stealth VRAM adapter with 1MB of video RAM rounds out the video subsystem in the unit.

Another choice component included in the HiQuality is the Adaptec EISA SCSI Master 32-bit host adapter. It uses the Intel 82355 bus-mastering controller and is well able to manage whatever devices you might install in any of the seven open drive bays stacked inside the chassis. The company offers two other Maxtor hard disks, the 340 LXT-340S and 535 LXT-535S. However, the performance of the installed 15-millisecond 200MB unit from Maxtor leaves a lot to be desired.

For an EISA-based system, the HiQuality scored in last place on our disk performance tests using a Maxtor LXT-213S SCSI hard disk without a caching controller. Other tests results were less

disappointing, with processor and memory scores clearly benefiting from the 256K of direct-mapped, buffered write-through secondary cache. The Diamond Stealth VRAM returned a respectable Graphics Winmark score of 8 million; its DOS video performance was characteristically lower due to its S3-based chip set.

Arguably, the HiQuality is overkill for most single-user applications—particularly if you get a better disk subsystem. What it lacks in hard disk performance scores is somewhat made up for in its graphics handling capabilities measured on our tests, but as a potential Windows graphics platform, you'll need better disk

FACT FILE

HiQ 43FE

HiQuality Systems Inc., 740 N. Mary Ave., Sunnyvale, CA 94086; 800-827-5836, 408-245-5836; fax, 408-245-3108

List Price (Tested Configuration): \$3,999.

Memory and processor RAM cache: 4MB 80-ns. SIMMs, 256K cache.

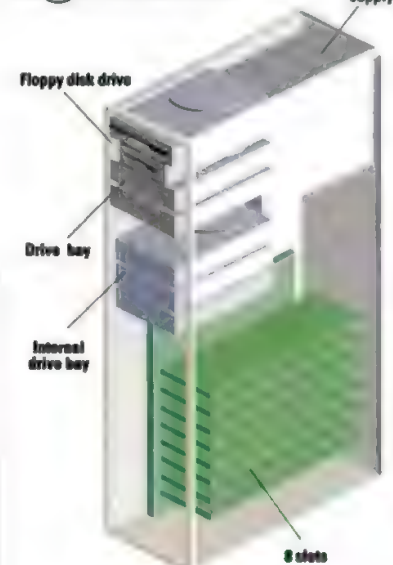
Disk drives and controller: Maxtor 15-ms. 200MB IDE hard disk, Adaptec controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB RAM, NEC 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The HiQ 43FE has the potential to be a big-system graphics workstation, but its small disk size doesn't measure up to big-system demands.

ON READER SERVICE CARD



performance from your system.

HiQuality Systems breaks down its standard warranty on the HiQ 43FE: one-year support for parts and two-year support for labor. A \$75 fee buys first-year on-site service from VAC; second-year coverage costs 15 percent of the system purchase price. HiQuality's toll-free support line accepts technical questions weekdays.—GP

IBM Corp.

IBM PS/2 Model 95 XP 486 25/50

It's big, it's blue, and it's a big-ticket item: It's the \$12,095 IBM PS/2 Model 95 XP 486 25/50. By far the most expensive PC here, the IBM managed only decent, not blinding, speed. Are size, features, and product support enough to warrant almost the same price as a midsize family car? You decide.

The large, mostly plastic PS/2-style blue-and-white tower case needs no tools to open and unfolds seven drive bays, which, if all are filled, are supposed to be powered by a pencil-necked 195-watt power supply with only three connectors. Switches are front-mounted, though IBM still insists on placing the keyboard connector in the rear.

The IBM's MCA motherboard holds eight expansion slots: Two of these are proprietary; one is already used for XGA. The DX2 processor sits in a standard socket mounted on an upgradable plug-in card. Like the other MCA system reviewed here, the NCR System 3335, IBM declined to add a processor RAM cache to its 4MB of system RAM (upgradable to a typical 64MB); Big Blue paid for it in performance clout—not a good idea considering the sticker-shock pricing. IBM's own 400MB hard disk is integrated onto the motherboard via a proprietary SCSI chip set with a 512K cache. An IBM XGA card has 512K of video RAM and holds true to Big Blue's ostrich philosophy con-

FACT FILE

IBM PS/2 Model 95 XP 486 25/50

IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-426-9292.

List Price (Tested Configuration): \$12,095.

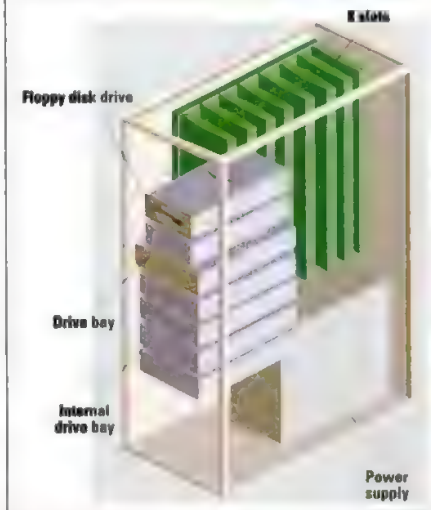
Memory and processor RAM cache: 8MB 70-ns. SIMMs.

Disk drives and controller: IBM 11.5-ms. 400MB SCSI hard disk, IBM controller, 512K cache, 2.88MB floppy disk drive.

Display: IBM 1,024-by-768 adapter with 512K RAM, IBM 14-inch monitor, 70-Hz refresh rate.

Software: None.

In Short: The IBM PS/2 Model 95 XP 486 25/50 lacks the performance and features to warrant its \$12,095 price.



cerning Super VGA resolution, supporting only 640-by-480 and 1,024-by-768 resolutions. The proprietary 14-inch

monitor is able to display this latter pixel density at a VESA-compliant 70 Hz. One serial, one parallel, and one PS/2 mouse port perforate the rear of the unit.

Performance was blunt. Processor and memory scores were predictably low because of the lack of a secondary cache. Disk scores were unremarkable, while video scratched the surface of good performance under DOS and then plummeted

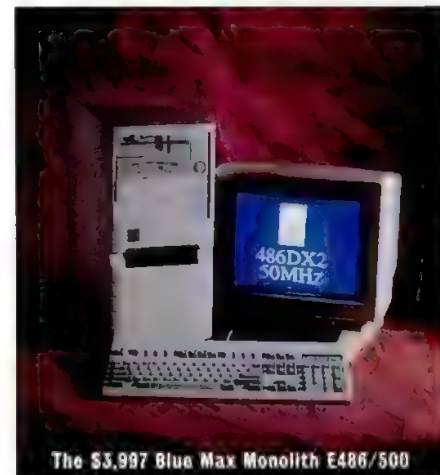
back into the realm of slightly below-average performance under Windows.

Other than IBM's logo, there is nothing about this system you can't find in numerous other units selling for less than half the Model 95's extravagant cost—except, perhaps, MCA (and even that is offered by NCR at a fraction of Big Blue's price). Since IBM sells this unit solely through dealers, warranties will vary, although the company does provide an 800 support number.—OR

International Instrumentation Inc.

Blue Max Monolith E486/500

International Instrumentation chose a popular motherboard to run its Blue Max Monolith E486/500. The EISA-bus Mylex MAE486, found in 486s from Zeos, Tangent, and other vendors, has always proved reliable. But you can find better price/performance value in other systems reviewed here, and even within the



company's own line of PCs.

The \$3,997 486 DX2 system we tested came with 4MB of RAM; a 128K direct-mapped, write-back cache; a 327MB hard disk; and accelerated 1,024-by-768 video. Shorter and chunkier than a conventional tower, the 18.5-by-7-by-18.5-inch Monolith holds the eight-slot EISA motherboard and six 5.25-inch drive bays. Four bays can accept removable media; five slots remain after you install the video, disk, and I/O cards.

Four of the system's eight SIMM sockets are hidden under the power supply. Don't expect to upgrade the CPU, either. The motherboard has no upgrade socket and does not support faster CPUs.



scores were unremarkable, while video scratched the surface of good performance under DOS and then plummeted

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The Blue Max's processor scores compared favorably with the other PCs. Memory performance was less impressive, despite the 128K cache. In this group, its memory score fell into the bottom 15 percent. Disk and video performance benefited from the unit's componentry: An UltraStor EISA controller with a 2MB cache boosted disk scores; the Diamond Stealth VRAM card, with an S3 chip, aided Windows performance.

A year's worth of on-site service is included in the system's price. The company also provides service within a 65-mile radius of its southern California headquarters; TRW handles the rest of the country. Service is available weekdays on a toll-free line.—Julie Cohen

FACT FILE

Blue Max Monolith E486/500

International Instrumentation Inc., 2282 Townsgate Rd., Westlake Village, CA 91361; 800-543-3475, 805-495-7673; fax, 805-379-0701

List Price (Tested Configuration): \$3,997

Memory and processor RAM cache: 4MB 70-ns SIMMs, 128K cache

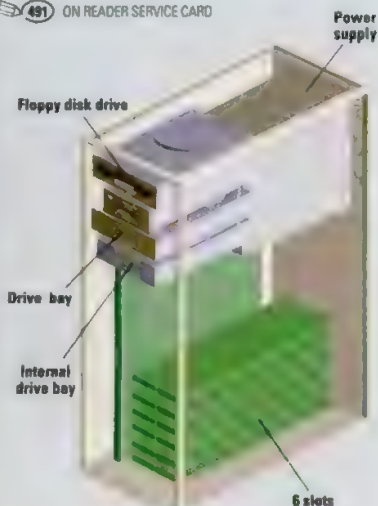
Disk drives and controller: Micropolis 14-ms. 327MB ESDI hard disk, UltraStor controller, 2MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB RAM, ViewSonic 14-inch monitor, 60-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1

In Short: III's excellent EISA and hard disk expansion compensate for reasonable performance at a relatively high price.

491 ON READER SERVICE CARD



Keydata International Inc.

Keydata 486-50 DX2 EISA Station

The \$2,595 price is right for an EISA small-footprint desktop, but the Keydata 486-50 DX2 EISA Station lacks the performance measures or smart design required to truly stand out from this PC



The \$2,595 Keydata 486-50 DX2 EISA Station

crowd of 63. The internal layout and performance figures of the Keydata prove the value of comparative analysis in making a buying decision. You can certainly find a more easily expansive and finely tuned system in a small-footprint design.

The Keydata's list price includes 4MB of system memory, 256K of processor RAM cache, a 212MB Western Digital IDE hard disk with Chicony controller and 64K disk cache. Our tested configuration includes a display subsystem based on a Diamond Stealth VRAM adapter with 1MB video memory connected to a ViewSonic 14-inch monitor.

Though this is an attractive, small-footprint PC and has a solid chassis construction, it is cramped inside. Most memory upgrade slots lie under the power supply and are hard to reach. Because of all the ribbon cables coming off the disk controller card, you may lose the use of the last three inside slots, and the last two can't hold full-length cards anyway because they are limited by the placement of the on/off switch. With the video card installed, a maximum of four EISA slots remain completely accessible. However, neither the installed disk controller nor the video card took advantage of EISA design.

The Keydata is marked by bland performance that is consistent with its component selection. The only score for this

system that keeps this machine in any way competitive with its peers is a Graphics Winmark rating of 6.65 million. Typical of S3 chip-based video adapters, however, it gains Windows performance at the expense of DOS. Similarly, the Keydata's 15-millisecond Western Digital Caviar 2200 IDE hard disk turned in nominal scores. Processor and memory performance was below par.

The Keydata comes backed by an 18-month warranty and \$150 per year on-site service handled by the company. Technical support is available weekdays and Saturdays on a toll-free line.—GP

FACT FILE

Keydata 486-50 DX2 EISA Station

Keydata International Inc., 111 Corporate Blvd., S. Plainfield, NJ 07080; 800-486-4800, 908-755-0350; fax, 908-756-7359

List Price (Tested Configuration): \$2,595

Memory and processor RAM cache: 4MB 60-ns SIMMs, 256K cache

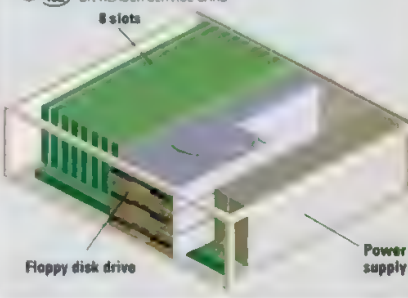
Disk drives and controller: Western Digital 14-ms 212MB IDE hard disk, Chicony controller, 64K cache, 1.2MB and 1.44MB floppy disk drives

Display: Diamond 1,024-by-768 adapter with 1MB RAM, Club 14-inch monitor, 72-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1

In Short: Keydata International's 50-MHz DX2 lacks the smart design and performance needed to distinguish it from other similarly priced EISA machines

492 ON READER SERVICE CARD



Leading Edge Products Inc.

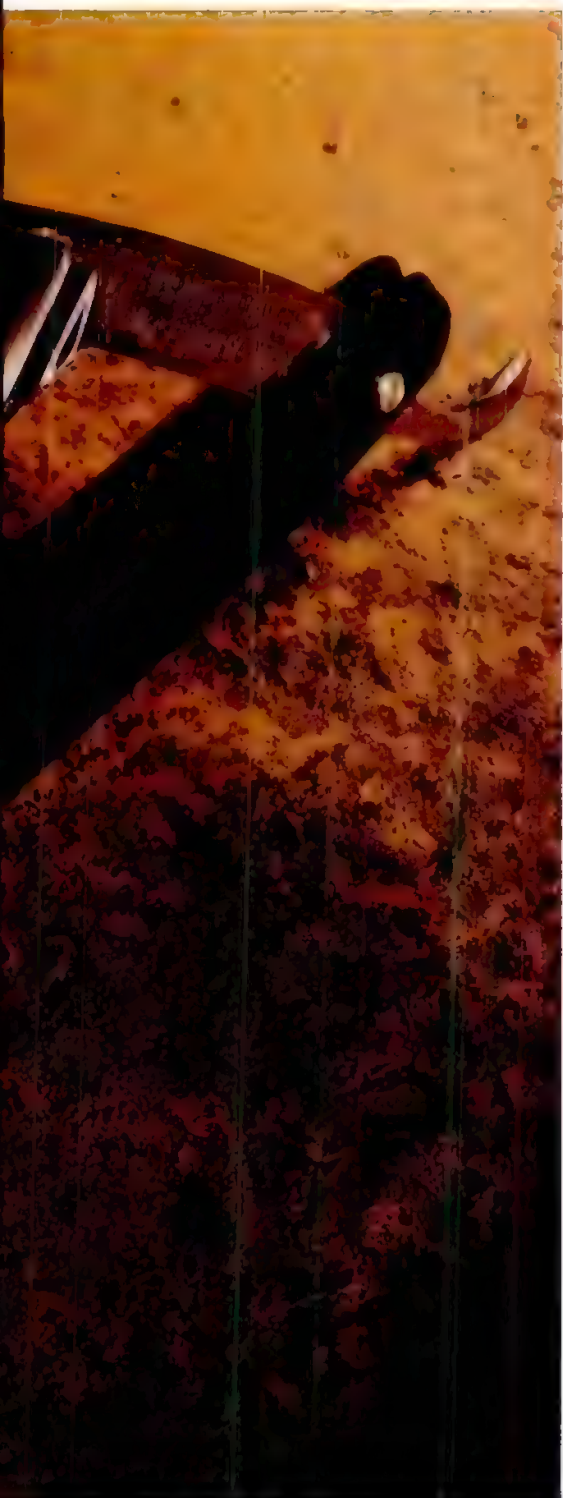
Leading Edge D4/DX2-50

The Leading Edge D4/DX2-50 pales before its competition. Priced at \$2,499 with 4MB of RAM and the popular Quantum 240MB hard disk, this small-footprint desktop system tended toward low performance except for the disk and DOS

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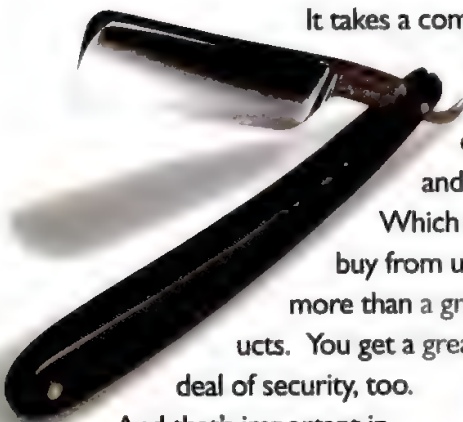
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- 64 KB Cache Memory
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- 2 Serial, 1 Parallel I/O ports
- DOS 5.0
- Windows 3.1
- Mouse
- Upgradable Processor Architecture Allows for Easy Upgrade to 486 CPU

**Corporate Series
386 DX 40**



**Corporate Series
486 DX 33**



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- 8 KB Internal Cache
- 4 MB RAM (Expandable to 64MB) Zero Wait State
- 64 KB Secondary High Speed Cache Memory
- 120 MB (19 ms) Hard Drive
- 3.5" 1.44 MB FDD
- 14" 28 mm Dot Pitch 1024 x 768 Ultra-High Resolution Flicker-Free Display (70 Hz Refresh)
- 2 Serial, 1 Parallel I/O ports
- DOS 5.0
- Windows 3.1
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- DOS 5.0
- Windows 3.1
- Mouse



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- 2 MB RAM
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- FastLynx
- Memory Expandable
- One Dedicated Internal Modem Slot



Super 386 SX 20

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- 60 MB Hard Drive
- VGA Supertwist Backlit CCFT (32 Gray Shade)
- DOS 5.0
- FastLynx
- Memory Expandable
- One Dedicated Internal Modem Slot



Super 386 SX 25

- 2 MB RAM
- 60 MB Hard Drive
- VGA Supertwist Backlit CCFT (32 Gray Shade)
- DOS 5.0
- FastLynx
- Memory Expandable
- One Dedicated Internal Modem Slot

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video scores. The only thing to get excited about is its low price.

The Daewoo ISA-bus motherboard has a Phoenix ROM BIOS, an OPTi chip set, and a 64K external RAM cache. The 32MB of RAM maximum fits into SIMM sockets on the motherboard, which also has eight ISA slots. The SIMMs in the tested machine were rated at an unusually slow 80 nanoseconds. The video subsystem provided with the Leading Edge includes an ATI 800-by-600 adapter with 512K of RAM and a Daewoo 14-inch monitor with a 60-Hz refresh rate.

Performance ranged from so-so to poor. The 64K direct-mapped processor RAM cache yielded processor and memory scores at the bottom of the scale. The hard disk score was decent, as was

DOS video, but the graphics video score was poor.

The case that the Leading Edge system uses has three accessible 5.25-inch drive bays and one internal 5.25-inch bay. To remove the case cover, you have to take out four screws on the back and two on each side, which creates more aggravation than usual. The documentation supplied with the system is generic for the whole line, with little information about the specific features of the DX2 system.

You'll find Leading Edge systems sold mainly through dealers, consumer stores, and superstores. One interesting feature is the buyer's choice of either a 20-month depot service center parts-and-labor warranty or a six-month on-site service contract with GE Computer Service. There is no 800 technical-support number.—BB



The \$2,499 Leading Edge D4/DX2-50

FACT FILE

Leading Edge D4/DX2-50

Leading Edge Products Inc., 117 Flanders Rd., Westborough, MA 01581; 800-874-3340, 508-836-4800; fax, 508-836-4504

List Price (Tested Configuration): \$2,499.

Memory and processor RAM cache: 4MB 80-ns SIMMs, 64K cache

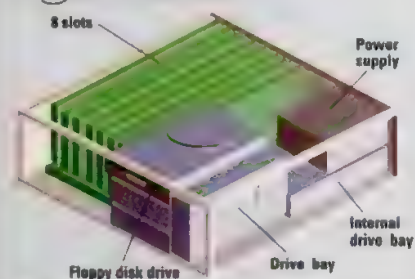
Disk drives and controller: Quantum 16-ms, 240MB IDE hard disk, 256K cache, 1.2MB and 1.44MB floppy disk drives

Display: ATI 800-by-600 adapter with 512K RAM, Daewoo 14-inch monitor, 60-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1, Microsoft Works for Windows

In Short: The Leading Edge D4/DX2-50 is a low-powered commodity ISA-bus desktop PC

ON READER SERVICE CARD



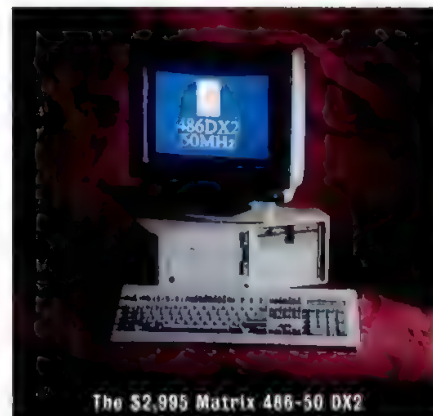
Matrix Digital Products Inc.

Matrix 486-50 DX2

A matrix can be defined as a strict pattern, and the \$2,995 Matrix 486-50 DX2 certainly followed one. Like umpteen other ISA machines seen here, the Matrix is put together from low-cost, off-the-shelf components. Its saving graces are a decent (though not champion) price and quality name-brand components that work exactly as they should.

A small-footprint case surrounds five front-accessible drive bays and a 200-watt power supply with five connectors. Though most of the switches and the keyboard connector are located up front, the power switch is left in the rear. Get with it, Matrix!

The Micronics Gemini DX2 motherboard uses Phoenix BIOS and holds eight ISA expansion



The \$2,995 Matrix 486-50 DX2

FACT FILE

Matrix 486-50 DX2

Matrix Digital Products Inc., 1811 N. Keystone St., Burbank, CA 91504; 800-227-5723, 818-566-8567; fax, 818-566-1476

List Price (Tested Configuration): \$2,995

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache

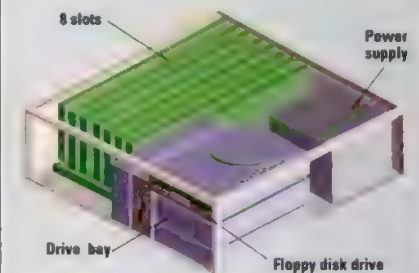
Disk drives and controller: Conner 16-ms, 212MB hard disk, UltraStor controller, choice of 1.2MB or 1.44MB floppy disk drive.

Display: Orchid 1,024-by-768 adapter with 1MB RAM, Matrix 14-inch monitor, 60-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1

In Short: A good system at a fair price. Matrix is worth a close look

ON READER SERVICE CARD



slots, one of which can double as a proprietary memory expansion slot. The motherboard could have also used a little more space: With 8MB of RAM installed, four expansion slots will be limited to only half-length cards. Further, the Intel 486DX2 processor lacked a heat sink. The system's 4MB of RAM (expandable to 32MB on-board and 64MB maximum), however, is backed by 256K of 20-nanosecond, direct-mapped, buffered write-through processor RAM cache.

The hard disk subsystem revolves around a 212MB Conner CP-3204 IDE hard disk that contains an internal 64K read-ahead buffer; it is connected to an UltraStor U15C IDE pass-through controller with 1MB of cache memory. Video is handled by an Orchid Pro-Designer IIs with a

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CIRCLE 371 ON READER SERVICE CARD

Tseng ET4000 chip and 1MB of video RAM—all hooked to a 14-inch Matrix Megaview monitor that can handle up to 1,024-by-768 resolution at a barely VESA-compliant 60-Hz refresh rate. An Orchid Fahrenheit adapter and superior MAG monitors are also available.

Performance is precisely what you would expect from these components, which isn't a bad thing. The processor RAM cache was well engineered and placed the Matrix in the top ten on our processor and memory tests. The Conner hard disk and its 64K internal buffer coupled with the 1MB UltraStor cache brought in average results (which could be improved by increasing the 1MB disk cache), while the Orchid board managed the usual Tseng-based numbers: good under DOS, poor under Windows.

Matrix sells the unit through dealers with a one-year parts-and-labor warranty and offers extra-cost on-site service. The company does not provide technical support.—OR

Mega Computer Systems

Mega Impact 486DX2/50E

The Mega Impact 486DX2/50E EISA-bus tower case system is a questionable value at \$3,775—unless you need a fast hard disk. Disk performance, which relied on a 340MB Micropolis SCSI-2 with a



64K data buffer and a Data Technology DTC EISA drive controller with a 2MB disk cache, took seventh place on our disk test. Nothing else is worth writing home about.

Our test unit came with 4MB of RAM (64MB system maximum). Its EISA-bus

FACT FILE

Mega Impact 486DX2/50E

Mega Computer Systems (a division of Mega Computer Corp.), 10840 Thornmint Rd., San Diego, CA 92127; 800-662-7775, 619-487-8888; fax, 619-485-1518

List Price (Tested Configuration): \$3,775.

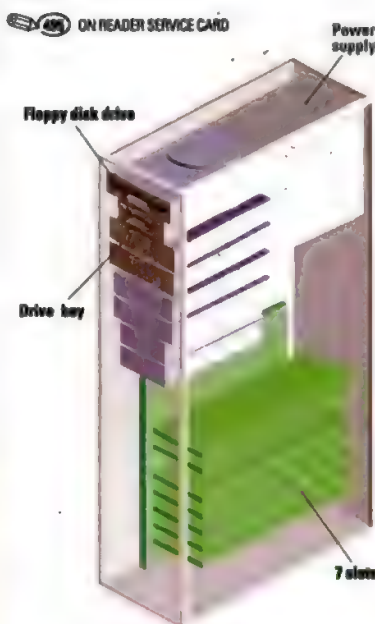
Memory and processor RAM cache: 4MB 80-ns. SIMMs, 256K cache.

Disk drives and controller: Micropolis 14-mb. 340MB SCSI hard disk, DTC controller, 2MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: ProLink 1,024-by-768 adapter with 1MB RAM. Amazing 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The Mega Impact 486DX2/50E costs more than the competition and has only marginal service and support.



BCM motherboard uses a proprietary slot for its upgradable CPU card, an Intel chip set, and an AMI ROM BIOS. An Intel cache controller chip manages a 256K look-aside, direct-mapped, write-through RAM cache. Mega paired an Amazing 14-inch 1,024-by-768 monitor with a ProLink PVGA video card that had an S3 graphics accelerator chip and 1MB of video RAM.

The tower case has appropriate expansion room for a file server and comes with two cooling fans and a 250-watt power supply. Eight drive bays meet expansion needs: four 5.25-inch drives are acces-

sible; two 5.25-inch and two 3.5-inch bays are internal. Besides the proprietary 32-bit CPU slot, the motherboard holds six EISA slots and one 16-bit ISA. One odd note was the use of a silicon paste to hold the expansion cards and drive logic cables in place.

Configured more as a file server than as a single-user platform, this system had top-notch disk performance to show for its run through PC Magazine Labs' tests. Despite the use of standard name-brand parts, other test scores were unremarkable. The S3 chip-based video implementation turned in so-so Windows video performance and a very low DOS video score. Processor and memory scores were average.

Mega has a one-year parts-and-labor warranty with no on-site service arrangement in place at this time, though a deal is reportedly pending. Toll-free technical support is available weekdays. Mega sells computers through many channels, including direct sales, dealers, VARs, and OEMs.—BB

Micro Express

ME 486-50/DX2

Though it has a low, \$2,499 price tag and performed respectably, the Micro Express ME 486-50/DX2 is obviously designed as a file server. In today's market, however, you'd be better off leaving this ISA-based DX2 off your network, opting instead for an EISA configuration (probably with a true DX/50-MHz processor) to run your network.

The cavernous 24- by 10- by 17.5-inch tower case encompasses ten drive bays:





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CIRCLE 139 ON READER SERVICE CARD

FACT FILE

ME 486-50/DX2

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-642-7621, 714-852-1400; fax, 714-852-1225

List Price (Tested Configuration): \$2,499.

Memory and processor RAM cache: 4MB 60-ns. SIMMs, 256K cache.

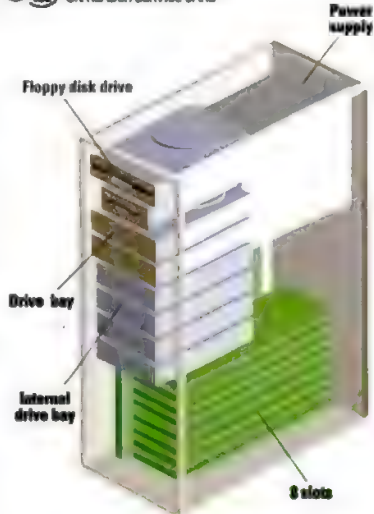
Disk drives and controller: Quantum 12-ms. 240MB hard disk, UltraStor controller, 8MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Pixel Engineering 1,024-by-768 adapter with 1MB RAM, CTX 14-inch monitor, 50- to 90-Hz refresh rate at 800-by-600.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: It is hard to be excited about an ISA-based tower. Performance is also undistinguished; look elsewhere.

ON READER SERVICE CARD



eight accessible 5.25-inch half-heights and two internal, as well as a muscular 375-watt power supply with ten connectors.

The Micronics motherboard holds eight ISA expansion slots, one of which doubles as a memory slot. Typical of Micronics motherboards, the memory is awkwardly configured: Four slots will not accept full-length cards if system memory is expanded, unnecessary in a case this size and a further blow if this system is intended for use as a file server. The unit's 4MB of RAM (32MB motherboard, 64MB system maximum) is backed by the usual Micronics implementation of a 256K processor RAM cache (direct-mapped, write-back).

The rest of this mammoth is made up of a 240MB IDE Quantum hard disk with a 256K internal buffer wired through an UltraStor 15C IDE pass-through controller with a powerful 8MB cache, though you can order a Micropolis 700MB or 2GB hard disk if you prefer. Pixels are powered by Pixel Engineering's Turbo Windows Accelerator board based on an S3 accelerator, carrying 1MB of video RAM and hooked to a 14-inch, mediocre CTX CXP-5468 Super VGA monitor capable of only 800-by-600 noninterlaced resolution at the usual VESA-compliant refresh rates (a multiscanning CTX monitor is also available).

Processor and memory test scores were at the top of our roundup (because of a well-implemented RAM cache); the Quantum hard disk and the massive 8MB UltraStor cache turned in very respectable performance results as well. The Pixel board, of course, managed only the usual S3 video scores: great under Windows, not so great under DOS.

Micro Express markets the ME 486-50/DX2 directly and includes a two-year parts-and-labor warranty (except for the hard disks, which are warranted for only one year), on-site service (\$50), and toll-free technical support.—OR

Micro Generation

Micro Generation MG50DX2

The \$3,195 Micro Generation MG50DX2 is huge. Aside from its girth, the system is well designed and performed competitively, although for a tower unit, an EISA bus would have been a better choice.

If you ever had a relative who sent



The \$3,195 Micro Generation MG50DX2

FACT FILE

Micro Generation MG50DX2

Micro Generation (a division of Continental Technology Inc.), 300 McGraw Dr., Edison, NJ 08837; 800-872-2841, 908-225-8899; fax, 908-225-8999

List Price (Tested Configuration): \$3,195.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 64K cache.

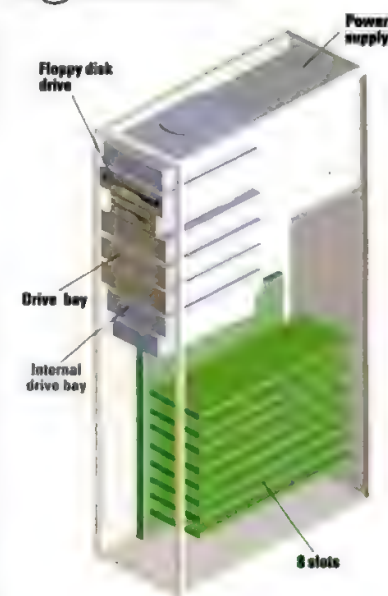
Disk drives and controller: Western Digital 15-ms. 212MB hard disk, Continental controller, 1.2MB and 1.44MB floppy disk drives.

Display: G-Host3 1,280-by-1,024 adapter with 1MB RAM, MAG 15-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1; choice of Norton Desktop for Windows, PC Globe, PC Paintbrush, or PFS:WindowWorks.

In Short: This is a good tower system, but an EISA design would have been a better choice.

ON READER SERVICE CARD



enormous presents, carefully packed in multiple boxes, this full-size tower will bring back memories; it arrived double-boxed and with enough padding for a safe trip down Niagara Falls. The case was well put together and had seven drive bays: five accessible 5.25-inch half-heights and two 3.5-inch internal bays. Power, turbo, hard disk lights, and an LED digital MHz indicator are front-mounted.

Thanks to Micro Generation's decision to place a baby AT motherboard in this cavernous case, the motherboard is completely free—not covered at all by

**QUICK. NAME TWO THINGS
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Generation in notebook PCs.



The 8MB/120MB DECpc 325P

Microprocessor: Intel i386SL running at 25MHz *Memory:* 8MB *Storage:* 3.5" 1.44MB Floppy, 120MB IDE Hard Disk *Display:* 10" Triple Super Twist Backlit, VGA LCD *Keyboard:* 84-key with inverted T cursor keys *Modem:* 2400 bps data, 9600 bps FAX (send/receive) *Pointing Device:* Built-in trackball *Battery Life:* 4 hours (NiMH Battery) *Software:* MS-DOS 5.0, Windows 3.1, FAXit for Windows, QA Plus Diagnostics, Choice of Lotus Software *Accessories:* Logitech TrackMan Portable, Black Nylon Carrying Case, AC Adapter *Price:* \$3,295

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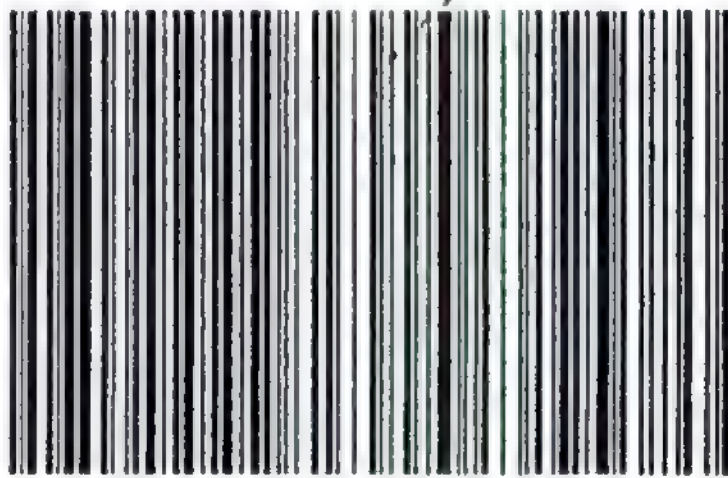
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1. Follow instructions on the other side

Back

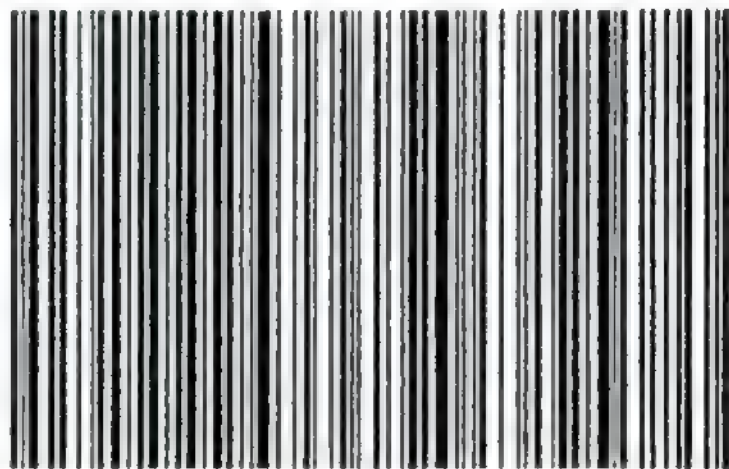
GbslipBack-0018



Inverted Back

1. Follow instructions on the other side

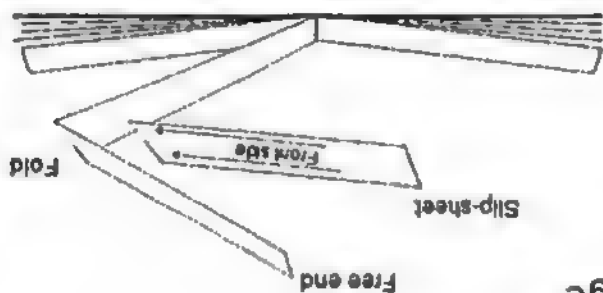
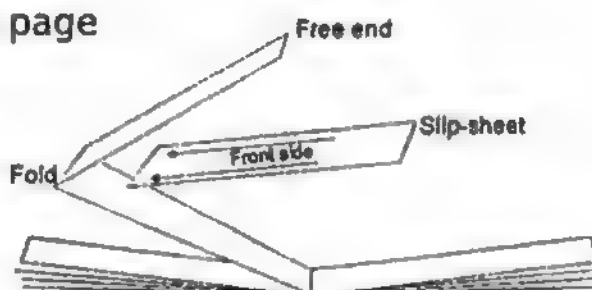
Folded edge of the page



GbsSlipSheet-001

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Introducing the next generation

The 4MB/80MB DECpc 325P

Microprocessor: Intel i386SL running at 25MHz *Memory:* 4MB *Storage:* 3.5" 1.44MB Floppy, 80MB IDE Hard Disk *Display:* 10" Triple Super Twist Backlit VGA LCD *Keyboard:* 84-key with inverted T cursor keys *Modem:* 2400 bps data, 9600 bps FAX (send/receive) *Pointing Device:* Built-in trackball *Battery Life:* 4 hours (NiMH Battery) *Software:* MS-DOS 5.0, Windows 3.1, FAXit™ for Windows, QA PLUS Diagnostics, Choice of Lotus Software *Accessories:* Logitech TrackMan Portable, Black Nylon Carrying Case, AC Adapter. *Price:* \$2,795

NiMH Battery for 4 hours of workpower.

2MB to 8MB of memory to accommodate anyone's demands.

External VGA monitor port lets you run external video and notebook display simultaneously!

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Intel i386SL running at 25MHz.

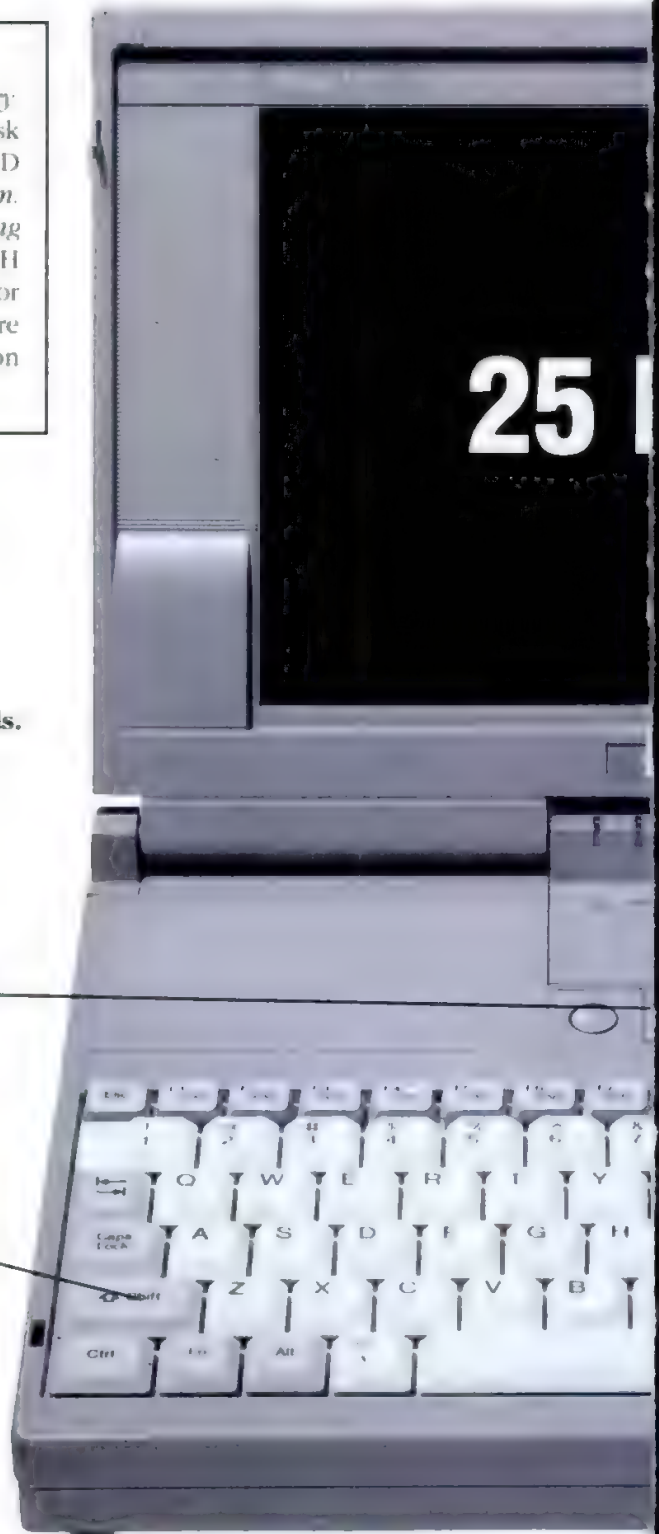
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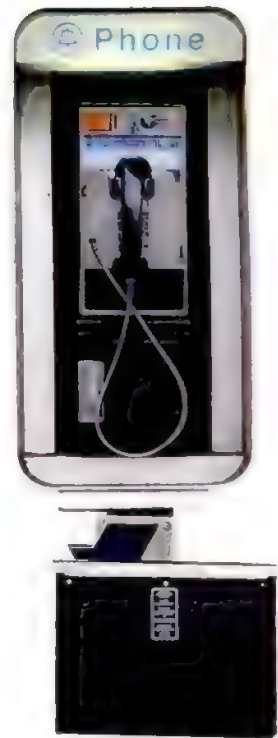
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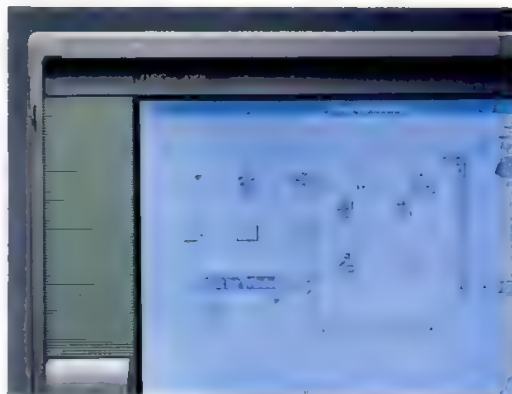
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The best features of all the best notebooks rolled into one — including price. That's what comes packaged with the new DECpc™ 325P. Beginning with a 25MHz Intel® i386SL processor. Your choice of 4MB RAM with an 80MB Hard Drive or 8MB RAM with 120MB Hard Drive. MS-DOS™ 5.0 and Windows® 3.1 are factory installed.

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Like all Digital Notebooks, the DECpc 325P also comes with "one of the most important hardware power saving capabilities found in SL systems —

Resume®, which allows the notebook to power down to the exact point where it left off" (INFOWORLD, June 8, 1992). In other words, it keeps your place in an application when you power down, and lets you pick right up without rebooting.

To make the DECpc 325P Notebook even easier to use in the toughest environments (at night on airplanes, in direct sunlight, etc.) we added a big 10-inch Triple Super Twist (TST), high-definition VGA Display. For working in close quarters, there's a trackball built right in. And, yes, we also included the popular Logitech™ TrackMan® Portable.



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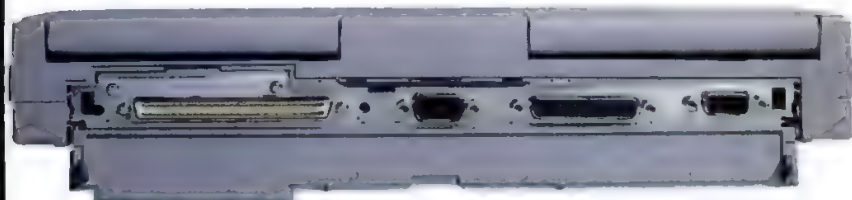
It's easy! Use the base system for the DECpc 325P in Column A and customize it with our special options from Column B. Then FAX it to us at 1-800-524-5694 and you'll have an estimate FAXed back to you pronto. So FAX today. And custom build your own DECpc 325P at real time speed and at a great price.

DECpc 325P

	COLUMN A Base system	COLUMN B OPTIONS (circle your choices)
Microprocessor:	Intel 25MHz i386SL	25MHz 80387SL 25MHz Coprocessor
Memory:	2MB	Upgrade to: 4MB, 6MB, 8MB
Storage:	3.5" 1.44MB Floppy, 80MB IDE Hard Disk	Upgrade to: 120MB IDE Hard Disk
Display:	10" Triple Super Twist Backlit VGA LCD	External 14" VGA Color Monitor
Keyboard:	84-key with inverted T cursor keys	Extended 101-key Industry Standard
Pointing Device:	Built-in Trackball Logitech TrackMan Portable	
Communication:	Serial, parallel port	9600 baud FAX/Modem Pocket Ethernet
Battery:	4-hour NiMH	Extra Battery Pack
Software:	MS-DOS 5.0, Windows 3.1, QA Plus Diagnostics, Choice of Lotus Software	
Carrying Case:	Black Nylon	Black Leather
Adapter:	AC	Car Adapter ALSO: Expansion Chassis, Portable Printer, FAX Modem, External 14", VGA, Color Monitor, External 101-key Industry Standard

Some notebooks make you give up comfort for features. Not the 6-pound DECpc 325P. This road wonder not only performs your applications remarkably well, it also lets you do video presentations from your Notebook, has all the ports you need and runs on a 4-hour NiMH battery but it does it all without intruding on your comfort zone.

It comes with a 10-inch display, 84 sculptured keys and both a built-in trackball and a Logitech TrackMan Portable. All housed in a mere 8.7 inches x 11.7 inches x 1.7 inches. Because the DECpc 325P was engineered to fit your suitcase, your briefcase, and your backpack — it was designed to fit all your needs, including your budget.



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Print Resolution:	300 x 300 dots per inch
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Envelope Handling Sizes:	Standard office envelopes
	Maximum width: 9.5", Maximum length: 4.3"
Paper Thickness:	19-24 lbs. (70-90 g/m2)
	Up to 36 lbs. manual feed
Print Modes:	Portrait and landscape
Optional Memory Upgrade Cards:	256KB
Resident Fonts:	Courier, Courier Landscape, Times Nordic (Times Roman)
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Cartridge Slots:	One (for font or emulation cartridges or RAM cards)

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DECjet 2000: Handles larger print runs with speed and reliability.



Print Technology:	Bubble ink-jet with 50-nozzle printhead
Printer Speed:	Up to 360 characters per second
Print Resolution:	300 x 300 dots per inch
Paper Handling Sizes:	8.5" x 11"; 8.5" x 10.5"; 8.5" x 14"
Envelope Handling Sizes:	Standard office envelopes
	Maximum width: 9.5", Maximum length: 4.3"
Paper Thickness:	19-24 lbs. (70-90 g/m2) Up to 36 lb. manual feed
Print Modes:	Portrait and landscape
Optional Memory Upgrade Cards:	256KB
Resident Fonts:	Courier, Courier Landscape, Times Nordic (Times Roman)
	Proportional spacing, Letter Gothic
Cartridge Slots:	Two (for font or emulation cartridges or RAM cards)

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the drive bays or power supply. Since one of the system's two fans is located right next to the processor, no heat sink is required. There are eight 16-bit ISA slots and one 16-bit ISA with a proprietary 32-bit extender. This last one is occupied by the Ghost3: a combination local bus video (with 1MB of video memory and the S3 GUI accelerator chip), I/O controller (two serial and one parallel), and an IDE hard disk controller. Unfortunately, the two built-in serial ports are positioned over one slot, blocking access to it.

The Micro Generation arrives with 4MB of RAM (32MB maximum); a 64K 20-nanosecond look-through, direct-mapped, write-back processor RAM cache; a Western Digital 4200 Piranha 212MB IDE hard disk (120MB and 80MB versions also available); and a MAG MX15 multiscanning monitor. The 15-inch MAG MX15 monitor is excellent, offering front-mounted digital controls and good performance. The only serious

flaw was the inadequate component-level documentation; nowhere was there a write-up concerning the system as a whole.

The Micro Generation PC's performance scores were better for Windows than for DOS because of the S3 accelerator. The small

64K secondary cache forced weaker processor and memory scores, though the Western Digital Piranha hard disk managed a competitive score.

Micro Generation sells the MG50DX2 with a one-year parts-and-labor warranty and toll-free technical support. On-site service is available for an additional charge.—OR

National Micro Systems Inc.

Flash 486DX2-50

The ISA-based DX2 machines in this roundup have had consistent trouble distinguishing themselves, and the \$2,399 Flash 486DX2-50 is no exception. The usual formula applies: an ISA bus and decent off-the-shelf components combined

to achieve a low price and average performance. If this is what you're looking for, the Flash is low-priced and good enough to be a contender.

A small-footprint case shows that the Flash has no delusions of file-server grandeur, but it manages to hold four front-accessible and one internal drive bay, as well as a 200-watt power supply with five connectors. Of course, the power switch and keyboard connectors are still rear-mounted in an archaic fashion, but you can't expect everything.

The AIR motherboard holds an ample eight expansion slots and one proprietary 32-bit slot reserved for RAM expansion. The ubiquitous 4MB of system RAM (expandable to the equally ubiquitous 32MB on-board and 64MB with an expansion card) is backed by a 256K direct-mapped write-through secondary SRAM cache. A 212MB IDE Western Digital WD2200 hard disk (you may also opt for a 340MB Maxtor unit) with an internal 64K read-ahead buffer talks to a UMC TC-1640 cacheless IDE pass-through controller; a S3 chip-based Diamond Stealth VRAM card carries 1MB of video RAM and holds a constant discourse with the 14-inch Addonics multiscanning monitor (capable of 1,024-by-768 non-interlaced resolution at 80 Hz). Surprisingly clear and concise documentation (for a clone) rounds out National Micro Systems' Flash 486DX2-50.

The SRAM processor cache did its duty and brought in decent scores for both our processor and memory benchmark tests. Its disk score was slightly below average (probably because of its small disk cache), while the S3 chip produced scores that were predictably poor under DOS and acceptable under Windows. If ISA-based DX2/50 performance is what you want, this one is as good as any and better than some.

National Micro Systems only sells the Flash 486DX2-50 direct and adds a 15-month parts and 24-month labor warranty, along with \$50 on-site service and toll-free technical support.—OR



The \$2,399 Flash 486DX2-50

FACT FILE

Flash 486DX2-50

National Micro Systems Inc., 2979-B Pacific Dr., Norcross, GA 30071; 800-642-7649, 404-446-0520; fax, 404-449-5297

List Price (Tested Configuration): \$2,399.

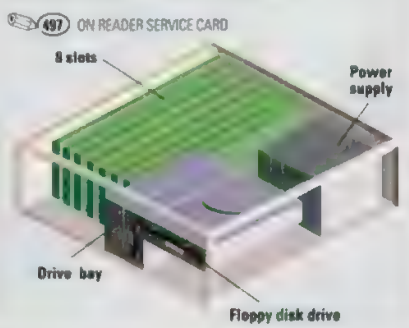
Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K cache

Disk drives and controller: Western Digital 14-ms, 212MB IDE hard disk, UMC controller, 1 2MB and 1.44MB floppy disk drives

Display: Diamond 1,024-by-768 adapter with 1MB RAM, Addonics 14-inch monitor, 80-Hz refresh rate at 1,024-by-768

Software: DOS 5.0, Microsoft Windows 3.1

In Short: National Micro Systems offers a competent ISA-based DX2 desktop at a good price

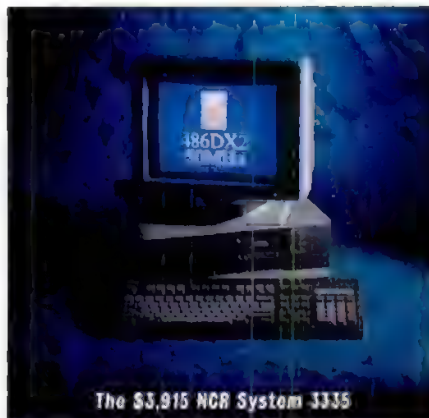


NCR Corp.

NCR System 3335

Buying the \$3,915 MCA-based NCR System 3335 is like mating for life. Because NCR Corp. keeps half the expansion bus of this average performer completely proprietary, you will most often be dealing with the same partner when you want to expand or upgrade.

The System 3335 arrived in a tightly



The \$3,915 NCR System 3335

FACT FILE

NCR System 3335

NCR Corp. (the Networked Computing Resource of AT&T), 1700 S. Patterson Blvd., Dayton, OH 45479; 800-225-5627, 513-445-5000

List Price (Tested Configuration): \$3,915.

Memory and processor RAM cache: 4MB 70-ns. SIMMs.

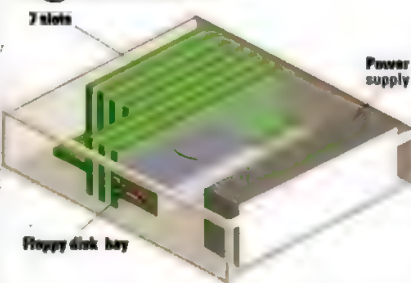
Disk drives and controller: Maxtor 15-ms. 212MB hard disk, NCR controller, 1.44MB floppy disk drive.

Display: 1,024-by-768 video adapter integrated on motherboard (not local bus), 1MB RAM, NCR 14-inch monitor, 80-Hz refresh rate at 800-by-600.

Software: None.

In Short: NCR Corp. is asking a lot but not providing the same with its System 3335. A Micro Channel alternative; that's all.

ON READER SERVICE CARD



packed slimline case. The case—built well and with thumbscrews—contains two front-accessible and one internal drive bay, as well as a 215-watt power supply with four connectors.

You can live with the slimline limitations, but NCR's motherboard is more difficult to accept. Though video and I/O ports are integrated, the rest of the board is largely proprietary. Half of this eight-slot MCA system is reserved exclusively for NCR upgrade products. These four slots are hugely extended and make up the bus-mastering Parallel Expansion Bus. Furthermore, the Intel 486 DX2 arrived fixed in a regular 486SX/25 socket neighboring an OverDrive socket. NCR bills this as an upgradable design, but with the DX2 in the main socket, the OverDrive is useless.

The only upgrade option is to pull the DX2 and replace it with a true 50-MHz DX. This won't be easy, since both the OverDrive chip and the standard processor sockets are stashed beneath the drive bay assembly. Also, the DX2 comes sepa-

rated from the single fan by the drive bays. Such an arrangement should really be mollified by a heat sink but isn't. The 4MB of system RAM (expandable to 192MB) is not backed up by a processor RAM cache (a big no-no in DX2 design). Also, the 212MB SCSI-2 Maxtor LXT hard disk (with a 32K look-ahead buffer) is connected to a proprietary NCR controller that goes into its own dedicated slot, thus robbing you of yet more slot freedom.

Video is on-board and controlled by NCR's own 22C22E chip set with 1MB of RAM. The 14-inch NCR monitor (an OEM from NEC, according to NCR) is capable of only 800-by-600 noninterlaced resolution at 60 Hz. A lonely 1.44MB floppy disk drive leaves one drive bay free for expansion. Neither DOS nor Microsoft Windows is being sold with the system (though NCR is presently thinking about bundling it). The Maxtor hard disk came completely unconfigured; be prepared for some high-level formatting.

With all this proprietary technology, you would expect to see some zippy performance, but the NCR ambled in alongside numerous peers and behind more than a few. Its lack of a secondary cache led to mediocre processor and memory scores; the NCR video chips dragged their feet under Windows but managed a serene trot under DOS graphics. The Maxtor hard disk and NCR's own controller brought in decent scores, but only if you consider that the controller lacked a cache.

NCR sells its brainchild direct and through dealers with a one-year parts-and-labor warranty, \$40 on-site service, and no toll-free technical support.—OR

NEC Technologies Inc.

NEC PowerMate 486/50i

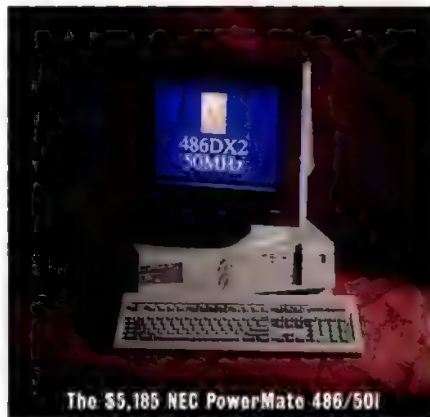
The \$5,185 NEC PowerMate 486/50i might not stand out in terms of performance, but it is distinguishable for its well-planned design and extra high-qual-

ity components. Yet other name brand systems like Compaq offer more performance, and lesser brands are much more economical.

The down-sized small-footprint case contains two front-accessible and two internal drive bays, though these are powered by an underpowered 110-watt power supply with four connectors. The case is an ergonomic model with a front-mounted power switch and keyboard connector, as well as an easy-entry design dependent on only one screw.

NEC Technologies' own G8KG motherboard uses a

Phoenix BIOS and holds four ISA slots on a T-bar arrangement perpendicular to the rest of the board. Though this seems like a small number, the video, floppy and hard disk controllers, and I/O ports are all integrated on the motherboard. The proces-



FACT FILE

NEC PowerMate 486/50i

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-632-4636, 508-264-8000; fax, 508-264-8488

List Price (Tested Configuration): \$5,185.

Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.

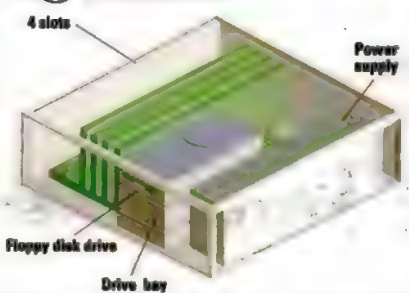
Disk drives and controller: NEC 16-ms. 240MB IDE hard disk, 256K cache, NEC 1.44MB floppy disk drive.

Display: NEC 1,024-by-768 local-bus adapter with 1MB VRAM, NEC 14-inch monitor, 70-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The NEC PowerMate 486/50i offers excellent construction in a well-designed small-footprint case, but price and performance must be more competitive.

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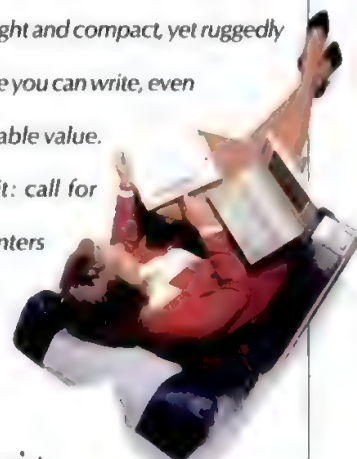
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processor is placed in a standard socket and configured with a heat sink. System memory can be configured up to 32MB and comes backed by a 128K processor RAM cache contained on an upgrad-

able plug-in module. NEC's own 240MB IDE GM24A372 hard disk (actually an OEM Quantum ProDrive LPS) contains an internal 256K buffer and is cachelessly integrated onto the motherboard. NEC's local-bus video implementation is still not

VESA-compliant but may have become so by the time you read this; inquire with NEC. Presently it is a proprietary configuration based around a Tseng ET4000 chip with 1MB of video RAM and connected to a 15-inch NEC MultiSync 4FG monitor, which, of course, can do 1,024-by-768 resolution at VESA's 70-Hz specification. On-board multimedia ports are optional.

The PowerMate's performance was respectable, with its local-bus video turning in a first-place score on our video test and an average Graphics Winmark timing. Its disk performance was very good, and the 128K secondary cache accounted for processor and memory scores in the tightly bunched competitive range.

The company sells the NEC PowerMate series through a network of dealers, so a street price might be available. The standard NEC warranty includes one-year on parts and labor, a nominal on-site service charge, and toll-free technical support.—OR

NETiS Technology Inc.

NETiS EISA 450DX2

The NETiS EISA 450DX2 is a largely unexciting, small-footprint desktop computer. With 4MB of RAM and a 212MB hard disk, the NETiS lists for \$3,150. Case quality is marginal and user support is typical of yesterday's retail-only vendors, but the unit's performance, price, and expansion (relative to case size) are all fine.

The Free Technology EISA-bus

motherboard implements an Intel chip set with discrete RAM cache-controller circuitry and an AMI BIOS. The 64MB RAM maximum fits on the motherboard in SIMM sockets. The video subsystem in-

cludes an Orchid Fahrenheit 1280° 1,024-by-768 adapter, an S3 graphics accelerator chip with 1MB of RAM, and a 14-inch ViewSonic 6 monitor with a 90-Hz refresh rate. The highest-performing component is the combined hard disk and controller.

The NETiS makes good use of its EISA architecture, pairing a 4MB DTC caching disk controller for the 15-millisecond 212MB Maxtor LXT213SY SCSI hard disk to capture sixth place on our disk test. The processor and memory scores also benefited from the 256K direct-mapped buffered write-through

RAM cache. The S3 chip-accelerated Fahrenheit card yielded solidly average Windows performance but dropped below average on DOS-based video.

The NETiS's case feels flimsy and has some sharp edges on internal support pieces. There are six EISA slots and two 16-bit ISA slots; six were empty on our test unit. Drive expansion room consists of five bays: four are accessible from the front (three 5.25-inch standard heights and one 3.5-inch slimline); the internal bay is a standard-height 3.5-inch.

NETiS sells through dealers, distributors, a direct-sales force, and VARs; it may be possible to negotiate a discount in some cases. The standard warranty covers parts and labor for one year. On-site service is available via the manufacturer for \$60 per year. Technical support is available weekdays but is not toll-free.—BB

Northgate Computer Systems Inc.

Northgate 486e

The Northgate 486e is a conventional EISA-bus system in a small-footprint, baby AT case. It sells for a rather high \$3,749 mail-order price with 4MB of RAM and a 240MB Quantum hard disk. This PC has better-than-average support and service policies and terrific documentation, but otherwise nothing stands out about this machine except its huge RAM capacity.



Northgate Computer Systems' proprietary motherboard can carry a whopping 128MB RAM maximum using SIMMs. It has an AMI BIOS; an OPTi chip set with 64K of direct-mapped write-back processor RAM cache, which can be expanded to 256K; and eight EISA slots—five were empty on our test system. An Orchid

FACT FILE

NETiS EISA 450DX2

NETiS Technology Inc., 1606 Centre Pointe Dr., Milpitas, CA 95035; 408-263-0368

List Price (Tested Configuration): \$3,150.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache.

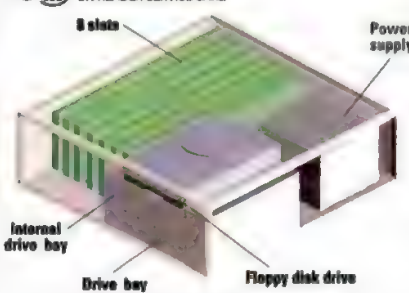
Disk drives and controller: Maxtor 15-ms. 212MB SCSI hard disk, DTC controller, 4MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Orchid 1,024-by-768 adapter with 1MB RAM, ViewSonic 14-inch monitor, 90-Hz refresh rate.

Software: DOS 5.0 or DR DOS 6.0, Microsoft Windows 3.1.

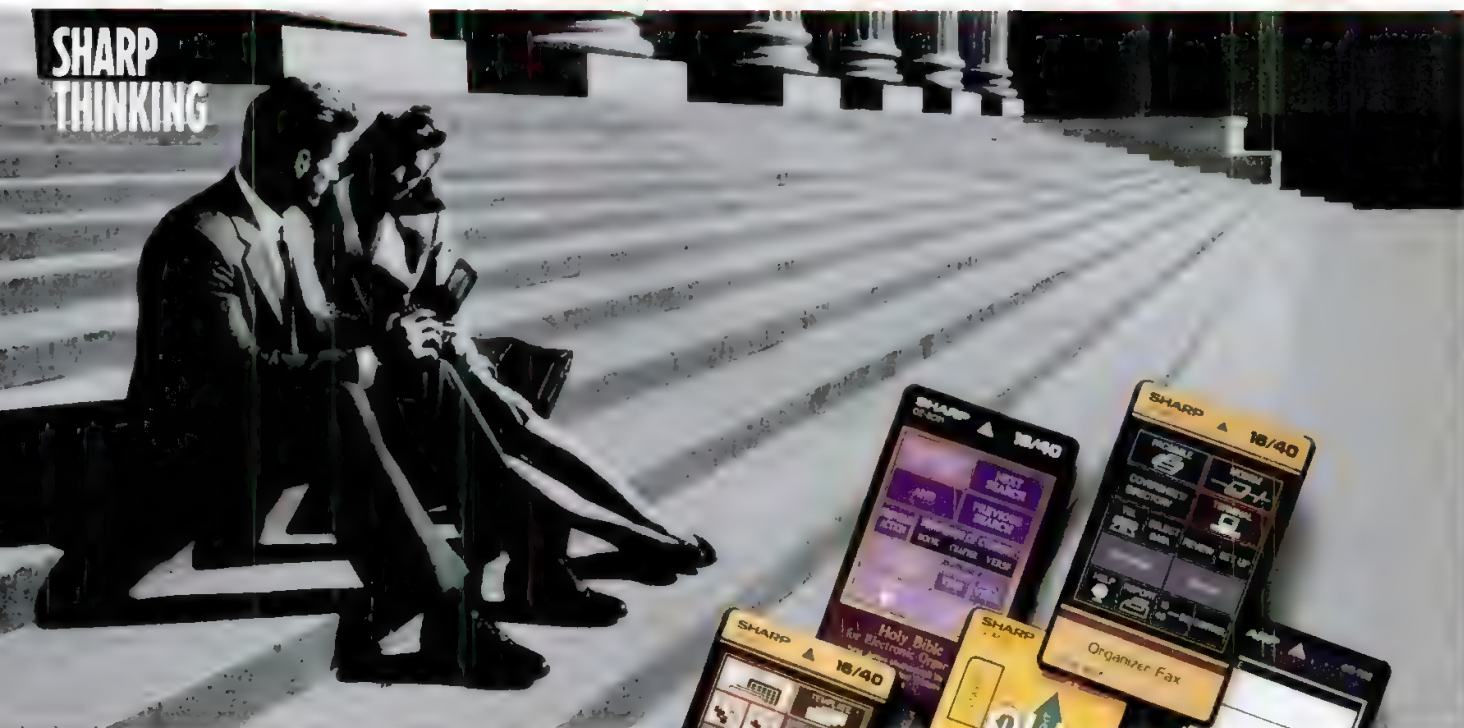
In Short: The NETiS EISA 450DX2 is a run-of-the-mill system with a hot drive and controller combination and S3 video acceleration.

ON READER SERVICE CARD

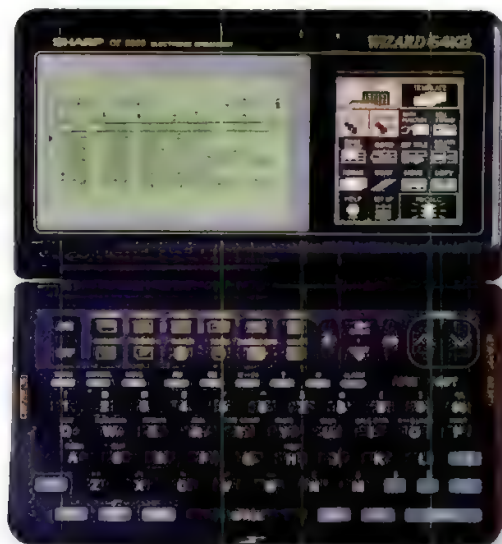


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Northgate 486e

Northgate Computer Systems Inc., P.O. Box 59080, Minneapolis, MN 55459; 800-548-1993, 612-943-8181; fax, 612-943-6965

List Price (Tested Configuration): \$3,749.

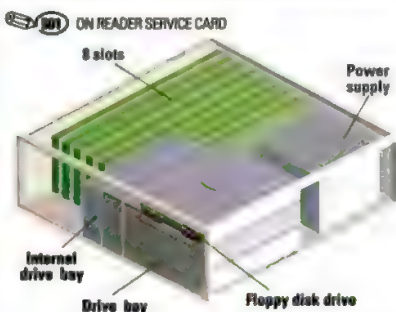
Memory and processor RAM cache: 4MB 70-ns. SIMMs, 64K cache.

Disk drives and controller: Quantum 16-ms. 240MB IDE hard disk, DTC controller, 256K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Orchid 1,024-by-768 adapter with 1MB RAM, Panasonic 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1, QA Plus.

In Short: The Northgate 486e, an EISA machine in a small case, has typical performance and a price a bit high for mail order, but it's saved by excellent user services.



Fahrenheit 1280° adapter with an S3 video accelerator chip and a 14-inch Panasonic 800-by-600 monitor round out the system.

The Northgate has another interesting feature: a combination 5.25-inch and 3.5-inch floppy disk drive that gives the user access to one more 5.25-inch bay. The case has five conventional drive bays, all accessible: three for 5.25-inch drives and two for 3.5-inch verticals. With the combination floppy disk drive in the test system, the computer can hold six devices in only five bays.

Since a 64K RAM cache does not do well on our processor test because it is too small to handle the file sizes that the test works with, the Northgate's processor and memory scores were low. The 16-millisecond Quantum ProDrive LPS240, used in

a number of other systems reviewed here, performed in the top middle of the pack. The S3 chip-based Fahrenheit video card gave a middling Graphics Winmark test result and a very low number on our DOS-based video test.

Northgate sells through direct mail but has one company store. The standard one-year parts-and-labor warranty includes on-site service via NCR at no charge during the warranty period. Extended warranties are available under various service plans. A toll-free technical support service is always there when you need it, 24 hours a day, seven days a week.—BB

Novacor Inc.

Novas Optimum 486 DX2-50

The \$2,845 Novas Optimum 486 DX2-50 packs some sound performance and really big RAM expansion—up to 128MB of system memory using 16MB SIMMs on the motherboard—into a very ordinary, bland-looking PC package. This AT-style desktop case features an EISA bus-mastering system board with an OPTi chip set and a 256K external RAM cache using write-back architecture. The system came configured with 4MB of RAM, a 256K RAM cache, S3 chip-based video, and a 240MB Quantum ProDrive LPS with a Promise controller holding a 4MB disk cache. Also included with the system is a 14-inch Relisys monitor and an Actix Graphics Engine Super VGA adapter with 1MB of VRAM.

While the design and physical dimensions of the chassis may seem outdated, it is still an expansive platform for the list of options Novacor offers. These include a selection of Quantum hard disks that range from 240MB to 425MB and a selection of Fujitsu units from 326MB to 513MB. Bus-mastering sets six of the system's expansion slots as master and two as slave, and the company begins offering an alternate Promise EISA IDE caching controller for its hard disks this summer. Video alternatives in-



clude a Tseng ET4000-based adapter for \$235 off the system price or a Sony CPD1304 for \$200 more.

Thanks to its OPTi 82C682 cache controller with 256K of direct-mapped write-back processor RAM cache and a Quantum hard disk with a 4MB cache, the Novas produced decent processor, memory, and disk performance. These components, also found in other systems

FACT FILE

Novas Optimum 486 DX2-50

Novacor Inc., 1841 Zanker Rd., San Jose, CA 95112; 800-486-6682, 408-441-6500; fax, 408-441-6811

List Price (Tested Configuration): \$2,845.

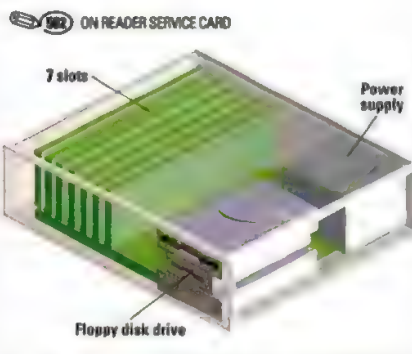
Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache.

Disk drives and controller: Quantum ProDrive 16-ms. 240MB IDE hard disk, Promise controller, 4MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Actix 1,024-by-768 adapter with 1MB RAM, Relisys 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0.

In Short: The Novas Optimum 486 DX2-50 offers big memory and processor cache expansion possibilities on a bus-mastering EISA board, but at a less than competitive price.



in this review group, gave consistently good results. The Novas also has an S3 chip-based Actix Graphics Engine video adapter; like other adapters based on the S3 chip, it characteristically did better on our Graphics Winmark test than on our DOS-based video test.

Novacor backs the Novas Optimum 486 DX2-50 with a two-year parts-and-labor warranty, with on-site service handled by TRW's PC Care program at \$45 for the first year and \$99 for the second. Like a car dealer, Novacor provides long-term leasing of its systems through a company called Business Credit Leasing.—GP

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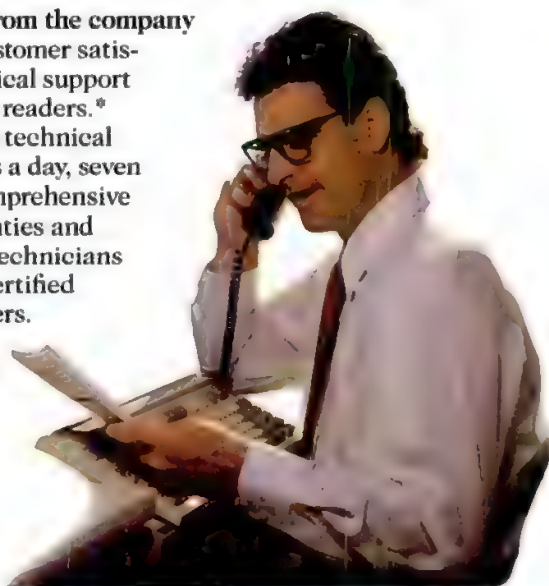


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Osicom Technologies Inc.

Osicom i450s

The 50-MHz Osicom i450s has one of the lowest prices of all the machines in this roundup. On our tests, however, its performance also came in at bottom-tier levels for the speedy DX2 class—a disappointing find in a system that to all appearances is a sturdy little machine, built tight and solid with an upgradable processor design, six ISA slots, and a standard 32-bit slot for memory expansion.

For an impressively low \$2,295 price tag, you can buy the Osicom with 4MB of RAM (32MB maximum), a 128K processor RAM cache, and a 200MB Seagate hard disk with a Microcom controller and a 32K cache. A Trident TVGA video adapter and an Amazing Technologies 14-inch monitor add Super VGA capabilities to the system, though not at the level needed for adequate graphics perfor-



The \$2,295 Osicom i450s

mance under Windows.

This small-footprint desktop DX2 has four drive bays. With the standard drives in place, there's room for only one additional 5.25-inch device. The number of options is also limited. Besides a 15-inch monitor for an additional \$215, Osicom Technologies offers a short list of hard disk options, including 600MB and 1.2GB IDE units. And if a DX2 is not to your liking, Osicom offers 33- and 50-MHz 486DX processor modules.

This PC's low processor and memory scores are a little surprising for a system with a 128K direct-mapped write-back RAM cache, but other reviewed systems with a UMC 82C481 cache controller have exhibited a similar tendency. Its disk and video scores were low as well.

FACT FILE

Osicom i450s

Osicom Technologies Inc., 198 Green Pond Rd., Rockaway, NJ 07866; 800-945-3456, 201-586-2550; fax, 201-586-9740

List Price (Tested Configuration): \$2,295.

Memory and processor RAM cache: 4MB 60-ns. SIMMs, 128K cache.

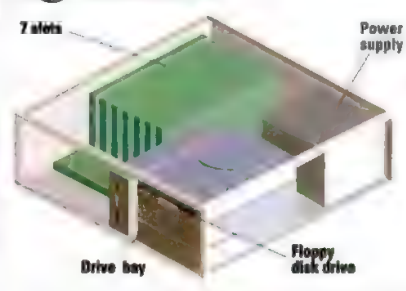
Disk drives and controller: Seagate 15-ms. 200MB IDE hard disk, Microcom controller, 32K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Trident 1,024-by-768 adapter with 1MB RAM, Amazing Technologies 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: The Osicom i450s's low price is matched by its low-end performance on our benchmark tests. The system is also too light on features and options.

ON READER SERVICE CARD



Osicom sells its DX2 with a one-year standard warranty on parts and labor and charges \$79 for on-site service arranged through the company. Service contract extensions for two or three years on all components and the display cost \$249 per year. A toll-free support line handles technical questions on weekdays.—GP

PC Brand Inc.

PC Brand 486/50 EISA Tower

The \$4,295 PC Brand 486/50 EISA Tower is an average machine. Its respectable construction is matched by off-the-shelf components that pull off average performance. Though the price is fair for an EISA system, similar or better machines are available for under \$4,000.

The huge 25- by 9.5- by 19.5-inch tower case holds eight bays—six front-accessible and two internal—along with an ample 300-watt power supply with five connectors. All switches are conveniently front-mounted and hidden behind a lock-



The \$4,295 PC Brand 486/50 EISA Tower

ing door for added security.

PC Brand uses its own motherboard and system BIOS. The motherboard holds one ISA slot and seven EISA slots, plus one proprietary slot reserved for memory expansion. The unit ships with at least

FACT FILE

PC Brand 486/50 EISA Tower

PC Brand Inc., 405 Science Dr., Moorpark, CA 93021; 800-722-7263, 805-378-7848; fax, 805-378-7801

List Price (Tested Configuration): \$4,295.

Memory and processor RAM cache: 8MB 80-ns. SIMMs, 64K cache.

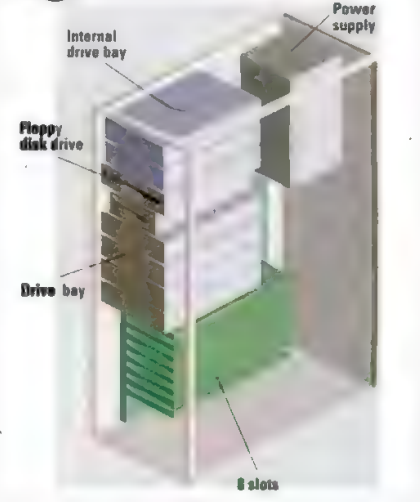
Disk drives and controller: Conner 15-ms. 212MB IDE hard disk, Epson 1.2MB and 1.44MB floppy disk drives.

Display: Orchid 1,024-by-768 adapter with 1MB RAM, Supercom 14-inch monitor, 80-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: PC Brand offers a competently average system at a higher-than-average price.

ON READER SERVICE CARD



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4MB of RAM (expandable to 64MB via a 64-bit proprietary memory board), but this is backed by an inadequate 64K 15-nanosecond processor RAM cache with a direct-mapped buffered write-through architecture. A 212MB IDE Conner 3205F hard disk is integrated onto the motherboard, while video is handled by a 16-bit ISA Orchid ProDesigner IIs with a Tseng ET4000 chip set and 1MB of video RAM. The system's monitor is a 14-inch Supercom, capable of just 800-by-600 resolution at 60 Hz.

Performance vacillated erratically between average and poor. The PC Brand's processor score was below average, while its memory result was in the upper half. The Orchid ProDesigner produced a video score typical of Tseng chip-based subsystems—good under DOS and poor under Windows—and the Conner hard disk fell among the slowest quarter of the 63 systems reviewed here.

This direct-sell-only system comes with a one-year parts-and-labor warranty, free on-site service, and toll-free technical support.—OR

Polywell Computers Inc.

Poly 486-50DX2

The Poly 486-50DX2 is a standard small-footprint EISA desktop computer. It sells for \$3,400 with 4MB of RAM (128MB maximum), a 212MB hard disk, and a 4MB caching disk controller. With a top processor score, an excellent disk score, and a longer-than-usual warranty, the Poly is well worth your attention.

The Poly's Intercomp motherboard has an AMI BIOS, an OPTi chip set, and a 256K direct-mapped write-back processor RAM cache. The video subsystem is based on an Orchid Fahrenheit 1280° video adapter that has an S3 graphics accelerator and 1MB of video RAM. It comes with a ViewSonic 4E 14-inch monitor that has a 70-Hz refresh rate at 800-by-600 resolution—low for this test group,

most of which could handle 1,024-by-768.

The Poly's processor score was the highest in a tightly bunched group, and its memory performance was good as well.

The DTC 4MB caching controller and the 15-millisecond 212MB Maxtor LXT213SY SCSI hard disk attained a near-top disk score. Polywell's video performance was consistent with that of the other S3 chip-equipped adapters.

You can remove the Poly's case top by simply unscrewing four small side screws. While this is less convenient than with back-mounted screws, adding components is easy, thanks to an accessible layout. The motherboard has eight EISA slots; five slots were empty on our test system. All five drive bays—three 5.25-inch and two

3.5-inch—can accept removable media.

Polywell Computers sells computers via mail-order, VARs, and an overseas distributor. The warranty covers labor for five year and parts for two years. On-site service is not free but costs a reasonable \$75 for the first year and \$170 for the second year, with service by Repair Technology International Network. Polywell has an 800 number for technical support available during weekday business hours only.—BB

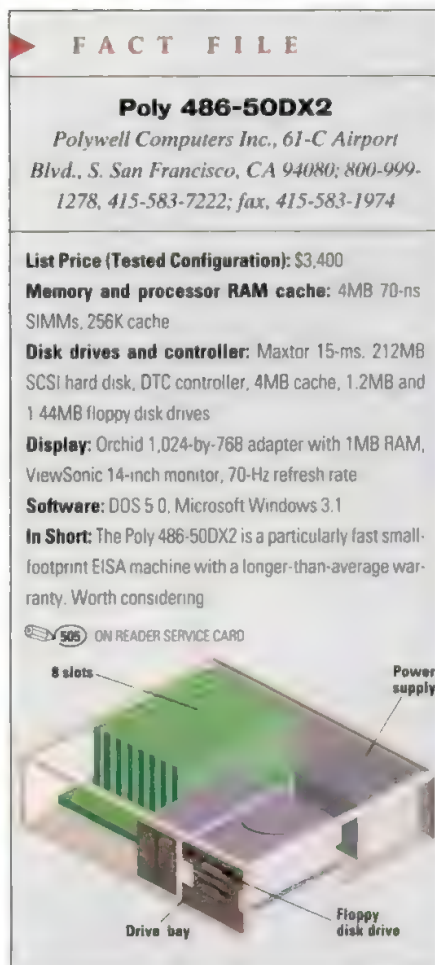
Sirius Systems Technology Inc.

SST 486DX2-50MWC

The \$2,800 SST 486DX2-50MWC is another low-priced EISA system, but the balance tips slightly in this PC's favor. Though its performance and design were average, the package was surprisingly full-featured for its price.

The SST comes in a sturdy full-size AT desktop case that surrounds five front-accessible drive bays and a 200-watt power supply with five connectors. The case holds all switches up front except power (which is on the right side); the keyboard connector is up front, too.

The SST Pro EISA motherboard has an Award BIOS, eight EISA expansion slots, and 2MB of RAM (32MB maximum) assisted by a 64K direct-mapped write-back processor RAM cache. The hard disk, a 212MB IDE Western Digital Caviar 2200 with a 256K buffer, is attached to a proprietary SST hard disk controller that can control two hard disks



and four floppy drives. Video, accelerated by an S3 chip with 1MB of video RAM, is powered by an STB Wind/X adapter hooked up to a 14-inch CTX CVP-5468NI monitor able to handle 1,024-by-

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CIRCLE 191 ON READER SERVICE CARD

FACT FILE

SST 486DX2-50MWC

Sirius Systems Technology Inc., 4344 Young St., Pasadena, TX 77504; 800-424-0724, 713-946-0724; fax, 713-946-5451

List Price (Tested Configuration): \$2,800

Memory and processor RAM cache: 4MB 70-ns SIMMs, 64K cache.

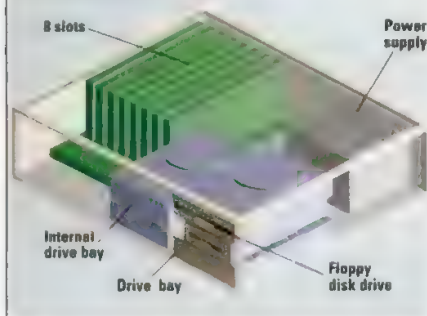
Disk drives and controller: Western Digital 13-ms. 212MB IDE hard disk, SST controller, 256K cache, 1.2MB and 1.44MB floppy disk drives

Display: STB 1,024-by-768 adapter with 1MB RAM, CTX 14-inch monitor, 60-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1

In Short: An okay performer with a great price for an EISA machine

ON READER SERVICE CARD



768 resolution at a 60- or 72-Hz refresh rate. Another STB adapter, the STB PowerGraph, is also available, and you can get either CTX's lower-end 5468NI or its high-end 17-inch flat-screen 1760 ProScan. The system is completed by Chinon 1.2MB and 1.44MB floppy disk drives, one parallel port, two serial ports, a PS/2-style mouse port, a 101-key Honeywell keyboard, a Logitech bus mouse, DOS 5.0, Microsoft Windows 3.1, Cache386, and PreCoursier (a menu program).

This PC is a very complete package, but performance is another matter. Both its processor and memory scores were poor, due to the small size of the RAM cache. Also, though the system is EISA, nothing in the disk subsystem takes advantage of this: the Western Digital Caviar unit is a regu-

lar IDE hard disk. The S3 STB Wind/X board scored well on our Graphics Winmark test, however—6.79 million.

Sirius Systems Technology offers a one-year parts-and-labor warranty, free on-site service, and toll-free technical support.—OR

Softworks Development Corp.

Citus MDC

Softworks Development Corp. has chosen flash over substance in the production of its 486 DX2/50 system. The \$2,430 Citus MDC looks good on a desk. It's solid with tempting power, turbo, and reset buttons, and an understated red and gray nameplate, but put the system to use and it can't keep up with the competition.

Our test system came with 4MB of RAM, 128K of direct-mapped write-back cache, and a 202MB Maxtor hard disk with a 32K buffer. The 1,024-by-768 video adapter with 1MB of video RAM was from Softworks; it was paired with a 14-inch Delta monitor capable of 1,024-by-768 noninterlaced.

The sum of all the parts did not add up to a set of decent benchmark test scores. While its score on our DOS-based video test was in the top 25 percent and its processor score safely in the middle of the pack, its other results were slow (particularly its memory score). Since Windows 3.1 video drivers were not yet available for the Western Digital WD90C30-LR

video chip set, we were forced to use Windows 3.0 drivers, which accounts in large part for the unit's poor showing on our Graphics Winmark test.

Inside the Citus are five 16-bit ISA slots (three were open on our test unit) and two 8-bit slots. The PC has a

hearty collection of drive bays: five front-accessible and two internal. Unfortunately, upgrading the RAM to its 32MB maximum would be difficult: The hard disk completely blocks four sockets.

On-site service is available from a third party for \$65 a year. Softworks offers the

FACT FILE

Citus MDC

Softworks Development Corp., 10202 N. Enterprise Dr., Mequon, WI 53092; 800-332-3475, 414-242-8800; fax, 414-242-8825

List Price (Tested Configuration): \$2,430.

Memory and processor RAM cache: 4MB 70-ns. SIMMs, 128K cache.

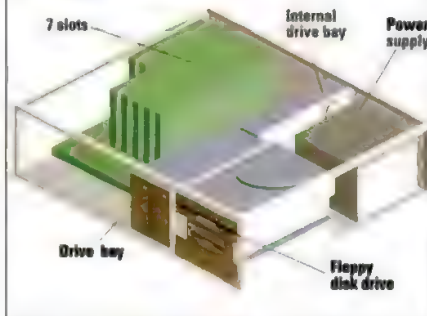
Disk drives and controller: Maxtor 15-ms. 202MB IDE hard disk, 32K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Softworks 1,024-by-768 adapter with 1MB RAM, Delta 14-inch monitor, 60-Hz refresh rate.

Software: None.

In Short: The Citus MDC looks good on a desktop but is a few steps behind the competition in performance.

ON READER SERVICE CARD



standard one-year warranty on parts and labor; technical support is a toll-free call.—Brad Grimes

Spear Technology Inc.

Spear 486 Convertible

The \$2,395 Spear 486 Convertible proves the old adage that looks aren't everything. Unfortunately, looks are all the



The \$2,395 Spear 486 Convertible



Come A Little Closer



June 30, 1992
Nanao Flexscan T560i



Nanao Flexscan T560i
and T660i



Nanao Flexscan T560i
and T660i



Nanao Flexscan T560i

T560i

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CIRCLE 283 ON READER SERVICE CARD

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We asked our customers what it is they want in the perfect notebook. The first thing they told us is that most notebooks look like a cigar box with a lid. They told us they wanted not only good looks, but things like great power *and* great battery life. Lightweight too, like five pounds and change. And the keyboard should be effortless to use. The entire product had to be extremely durable. And that was just for starters.

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Lots else! Like the best display system of any notebook available anywhere. We listened here too. The screen is big and easy to read. Plus, it's high contrast and it's fast. It's also very easy to adjust. People said contrast and brightness knobs were hard to use. So we replaced them with soft touch buttons that *electronically* adjust screen settings at your command. Then we really got creative.

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could we. So why not incorporate that feature into a notebook. With the ZEOS Freestyle/SL notebook you can adjust the screen left and right as well as tilt it up and down. Now you can truly adjust your notebook screen to the perfect viewing angle.

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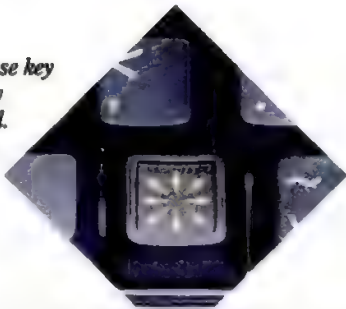
And then there is the "floating" screen. When you're facing your new ZEOS Freestyle/SL, the screen actually appears to "float" in the air in front of you. It's the only notebook that can really be used sitting on your lap!

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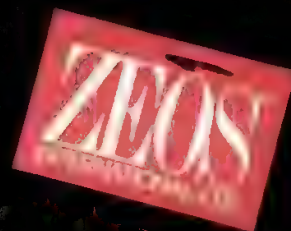
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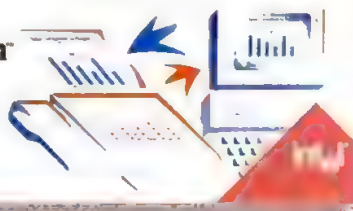


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Intel SatisFAXtion Modem/400e

The best modem. The best fax. Communicate with everyone.

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CIRCLE 342 ON READER SERVICE CARD

SUMMARY OF FEATURES

486DX2 PCs

List price (PC Magazine configuration) For this review of 50-MHz 486DX2 computers, we requested a configuration that included 4MB of RAM, a 200MB hard disk, a Super VGA color display subsystem capable of 800-by-600 resolution with 256 simultaneous colors (though we accepted 1,024-by-768 as well), one parallel and two serial ports, DOS 5.0, and Microsoft Windows 3.1

Unless otherwise noted, all table entries refer to the range of options available in the systems reviewed

Distribution channel Some machines are sold directly through mail order, others through dealers. Dealers have previously offered discounts of 25 percent or more off the list price, however, an industry-wide price restructuring has cut these discounts in many cases. PC Magazine views a 15 percent discount as typical

The **chip set manufacturer** makes the logic that connects the CPU with the other functions managed by the system board

System shadowing/Video shadowing Shadow RAM is a technology that loads system BIOS or video BIOS from slower ROM into faster RAM on boot-up, offering enhanced performance speed. Shadowing uses RAM located between 640K and 1MB

A **ZIF (zero-insertion-force) socket** has a lever that allows you to remove and replace the CPU easily

The **BIOS version (or date)** can affect PC Magazine Labs' benchmark test results. A machine with a different BIOS may perform differently

Flash memory contains BIOS code that can be updated via software. The BIOS is generally stored in

conventional ROM, which has no provision for modification

Installable RAM indicates the amount of memory that can be installed using any combination of chips and proprietary cards

The **cache controller** determines the amount of information that is taken from the processor or main memory and held in the cache

Cache architecture A four-way set-associative cache, native to the 486's internal 8K cache, divides data into four equal blocks and is viewed as most effective. A two-way cache's data is split into two equal blocks, and the data in a direct-mapped cache (the most common and least costly) is not divided

Cache write policy A write-back design can cache data read from and written to memory. This method is theoretically superior to that of a write-through cache, in which only reads from memory are cached

Front-accessible drive bays can be reached from the system's front panel and can support removable media (such as tape and CD-ROMs). **Internal drive bays** can be reached only by opening the case. We report the maximum number of accessible and internal drives the system can hold.

Floppy disk drives indicates whether the vendor equips its base-priced system with a 1.2MB floppy disk drive, a 1.44MB floppy disk drive, or both

Hard disk options We report the range of hard disk capacities the vendor offers

Disk controller location A computer with IDE (integrated drive electronics) circuitry has its controller

functions integrated into the drive and motherboard but may have a separate controller

Expansion bus For each type of expansion slot—8-bit, 16-bit, 32-bit EISA/MCA, and 32-bit proprietary—we report the number of slots that are found on the PC's motherboard. We also indicate whether the motherboard contains integrated parallel, serial, or mouse ports. Almost all the reviewed systems that feature 32-bit expansion slots use the EISA architecture, the exceptions are the PCs submitted by IBM and NCR, which are 32-bit MCA machines

The **display circuitry** can reside on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled there is no way to upgrade it.

The **video chip set manufacturer** makes the logic that runs the video adapter

The **number of device connectors** indicates how many internal storage devices the power supply can support without requiring Y cables (power splitters).

The **first-year on-site service charge** may be included in the price of the system, or it may be a set or variable amount. If the charge varies, it is often determined by the system's configuration and cost.

FCC Class B identification number Systems with a Class B rating from the Federal Communications Commission have sufficiently low radio-frequency emissions to be used in the home. To verify any system's status, you may dial up the Public Access Link, the FCC's own bulletin board service, at 301-725-1072

CONTINUES

Spear has going in its favor.

The large and rugged black tower case harbors four front-accessible and three internal drive bays. A 250-watt power supply squats in one corner, extending five connectors.

The Quickpath Evolution 486 motherboard accommodates eight ISA slots and the processor in a nifty zero-insertion-force (ZIF) socket. The 4MB of system RAM can be upgraded to 32MB but are reinforced only by a puny 64K

secondary cache. The 245MB IDE Quantum ProDrive was a good choice (you can opt for a 520MB Fujitsu unit), though it might have fared a little better if its pass-through controller had a memory cache. (What's the point of using a pass-through IDE connector if it doesn't have a cache? Run it off the motherboard and at least free up a slot.) The S3 chip-based Pixel Engineering Turbo Windows Accelerator board hefts the usual 1MB of video RAM and comes attached to a 14-inch Antec

CM-1402 monitor that handles standard resolutions up to 1,024-by-768 non-interlaced at a flickering 60 Hz (a ViewSonic 5E is an option).

Somebody has to place last, and the Spear managed to come very close to this on our benchmark tests: sixty-second on our processor and video tests and last on our memory test. Its Graphics Winmark score was okay for an S3 chip-based PC, and the Quantum hard disk turned in its usual reliable numbers, but this isn't what

► SUMMARY OF FEATURES

486DX2 PCs

In alphabetical order by company ■ = YES □ = NO	AcerPower 486DX2/50 WU	ACMA 486DX2/50	Altec 486DX2 Local Bus	Amax 486DX2 Power Station	Amkly 486DX2/50E	Arche Legacy 486/50DX2	Ares 486-50DX2 Sonic III
List price (PC Magazine configuration)	\$6,195	\$3,995	\$2,780	\$3,478	\$5,140	\$4,025	\$3,195
Hard disk capacity	212MB	240MB	212MB	240MB	397MB	212MB	240MB
Distribution channel	Dealers	Direct	Direct	Dealers	Dealers	Dealers	Direct
Case style	Desktop	Desktop	Tower	Desktop	Small-footprint	Desktop	Desktop
Bus architecture	ISA	EISA	ISA	EISA	EISA	EISA	ISA

Motherboard

Motherboard manufacturer	Acer	Helm Engineering	Gigabyte	Amax	Amkly	Arche	Ares
Chip set manufacturer	SIS	Intel	UMC	Intel	Intel	OPTi	VLSI
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
ZIF (zero-insertion-force) socket	□	□	□	□	■	□	□
Upgradable processor	■	□	■	■	■	□	■
BIOS version (or date)	Acer 1.2R1	Award 4.00	AMI (May 1991)	Award 4.00	Phoenix 1.00	AMI (July 1991)	AMI (May 1991)
Flash memory	□	□	□	□	■	□	□

Memory and Processor RAM Cache

Installable RAM	4MB-64MB	1MB-64MB	1MB-32MB	1MB-64MB	1MB-64MB	4MB-80MB	4MB-64MB
Cache controller	SIS	Intel	UMC	Intel	N/A	OPTi	Northport
Installable RAM cache	64K-256K	256K	256K	256K	N/A	256K	128K-512K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	N/A	Direct-mapped	Direct-mapped
Cache write policy	Write-through	Write-through	Write-back	Write-through	N/A	Write-back	Write-back

Disk Drives

Front-accessible drive bays	Three 5.25-inch, one 3.5-inch	Three 5.25-inch	Six 5.25-inch	Three 5.25-inch, two 3.5-inch	Two 5.25-inch, one 3.5-inch	Three 5.25-inch	Two 5.25-inch, two 3.5-inch
Internal drive bays	1	2	1	None	1	2	2
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB	1.2MB, 1.44MB
2.88MB floppy disk drive available	□	□	□	■	□	□	□
Hard disk options	212MB	240MB	212MB-678MB	52MB-1.4GB	40MB-2GB	212MB	120MB-425MB
Disk controller location	Card	Card	Card	Card	N/A	Card	Card

Expansion Bus

8-bit slots	None	None	1	None	None	None	None
16-bit slots	8	None	7	None	None	None	6
32-bit EISA/MCA slots	None	8	None	8	7	8	None
32-bit proprietary slots	None	None	2	None	2	None	2
Parallel, serial, mouse ports on motherboard	0, 0, 1	None	None	None	1, 2, 1	None	None

Video

Display circuitry location	Card	Card	Card	Card	Motherboard	Card	Card
Video chip set manufacturer	ATI	ATI	S3	S3	Trident	Tseng	S3

Power Supply

Power supply (watts)	200	250	250	250	200	200	200
Number of device connectors	6	5	8	6	4	6	5

Miscellaneous

DOS 5.0	■	■	■	■	■	■	■
Microsoft Windows 3.1	■	■	■	□	■	■	■
Warranty	1 year	1 year	2 years	1 year	1 year	2 years	2 years
First year on-site service charge	N/A	Included	Included	N/A	Included	Included	Included
FCC Class B identification number	G08P33W	IR7ACMA4860	None	FKCAMAX486E	1FWAKREN48625E	None	I8IAMI342DX

N/A—Not applicable. The product does not have this feature. AIR—Advanced Integration Research, AST—AST Research Inc., ATI—ATI Technologies Inc., C&T—Chips & Technologies Inc., DFI—Diamond Flower International, SDC—Softworks Development Corp., SIS—Silicon Integrated Systems Corp., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Corp.

FACT FILE

Spear 486 Convertible

Spear Technology Inc., 425 Country Club Dr., Bensenville, IL 60106; 800-852-4202, 708-616-7800; fax, 708-616-7811

List Price (Tested Configuration): \$2,395.

Memory and processor RAM cache: 8MB 70-ns. SIMMs, 64K cache.

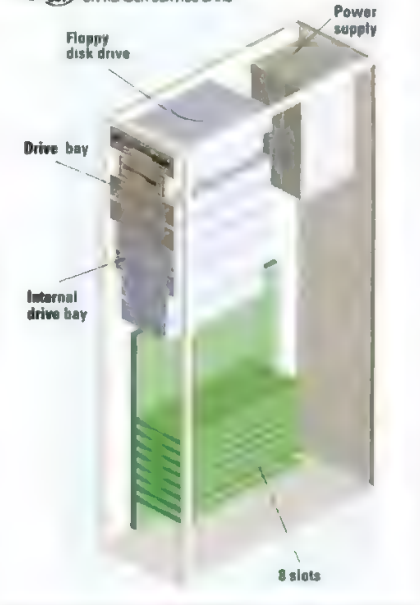
Disk drives and controller: Quantum 16-ms. 245MB IDE hard disk, Kouwell controller, 256K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Pixel Engineering 1,024-by-768 video adapter with 1MB RAM, Antec 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: A competitive price is offset by the Spear's generally poor processor and memory performance.

 ON READER SERVICE CARD



you would call a high-performance PC.

The company sells the Spear 486 Convertible direct and adds a one-year parts-and-labor warranty, free on-site service, and toll-free technical support.—*OR*

Standard Computer Corp.

Advantage 486 DX2/50

Standard Computer Corp. likes to bundle complete hardware and software packages. The Advantage 486 DX2/50 is no exception. Selling for \$3,275 with 4MB of RAM and a 240MB hard disk, the Advantage comes with a mouse, fax modem, DOS 5.0, Microsoft Windows 3.1, Norton

Ariel 486DX2-50	AST Power Premium 4/50d	ATronics ATI-486/50DX2	Austin 486 WinStation DX2-50	Axik Ace Cache 486DX2-50	C²Saber DX/2
\$2,695	\$4,790	\$2,095	\$2,990	\$2,848	\$3,125
240MB	210MB	212MB	200MB	212MB	212MB
Direct	Dealers	Dealers, direct	Direct, company stores	Direct	Dealers
Tower	Small-footprint	Tower	Small-footprint	Small-footprint	Tower
ISA	EISA	ISA	EISA	ISA	ISA

Micronics	AST	ATronics	Austin	Axik	ERI
Micronics	Intel	UMC	Intel	Coutaq	Symphony
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
□	□	□	□	■	□
□	■	■	■	■	■
Phoenix 2.0	AST 1.01	AMI (July 1991)	AMI (May 1991)	AMI (December 1991)	AMI (July 1991)
□	■	□	□	□	□

1MB-64MB	4MB-80MB	1MB-64MB	4MB-64MB	1MB-32MB	1MB-64MB
Micronics	N/A	UMC	Discrete logic	Coutaq	Symphony
256K	N/A	64K-256K	64K-256K	64K-256K	64K
Direct-mapped	N/A	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Write-through	N/A	Write-back	Write-back	Write-back	Write-through

Four 5.25-inch	Three 5.25-inch	Three 5.25-inch, two 3.5-inch	Three 5.25-inch	Three 5.25-inch, one 3.5-inch	Four 5.25-inch, one 3.5-inch
2	2	None	1	1	3
1.2MB, 1.44MB	1.2MB	1.2MB, 1.44MB	1.2MB	1.2MB, 1.44MB	1.2MB, 1.44MB
□	□	□	■	■	■
120MB-520MB	1MB-210MB	115MB-500MB	40MB-1.2GB	40MB-1GB	80MB-212MB
Card	Motherboard	Card	Card	Card	Card

None	None	1	None	None	1
8	None	7	None	8	7
None	6	None	6	None	None
1	None	1	1	1	None
None	1, 2, 1	None	1, 2, 0	None	None

Card	Motherboard	Card	Card	Card	Card
Tseng	WD	Tseng	WD	S3	S3

250	145	250	200	230	250
5	4	4	5	5	5

■	■	■	■	■	■
■	■	■	■	■	■
1 year	1 year	1 year	1 year	13 months	1 year
Included	N/A	\$99	Included	N/A	Included
None	None	E8M5IGAT140X	HA7ACS486E	I58ACECACHE486DSX	None

CONTINUES

COVER STORY
50-MHz DX2s

► **S U M M A R Y O F F E A T U R E S**

In alphabetical order by company ■ = YES □ = NO									
		Clover 486 EM II	Club Falcon 450 DX2	Compaq Deskpro 50M	Compudyne 4DX/250	Computer Sales Professional Pro 486DX2/50	Comtrade 486 EISA WinStation	CSS Preferred 425/50 GE	
List price (PC Magazine configuration)		\$4,995	\$2,920	\$4,897	\$1,999	\$1,999	\$2,975	\$3,921	
Hard disk capacity		212MB	240MB	212MB	212MB	121MB	240MB	202MB	
Distribution channel		Dealers, direct	Dealers	Dealers	Direct, superstores	Direct	Direct	Dealers, direct	
Case style		Desktop	Tower	Small-footprint	Small-footprint	Tower	Tower	Desktop	
Bus architecture		EISA	ISA	EISA	ISA	ISA	EISA	EISA	
Motherboard									
Motherboard manufacturer		Mylex	Club	Compaq	Compudyne	Symphony	Elisa Technology	CSS	
Chip set manufacturer		Proprietary	Club/VLSI	Compaq	UMC	Symphony	OPTi	Intel	
System shadowing/Video shadowing		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	□ □	
ZIF (zero-insertion-force) socket		□	□	□	□	□	□	□	
Upgradable processor		□	■	■	■	□	■	■	
BIOS version (or date)		Mylex (October 1991)	AMI (March 1991)	Compaq (February 1992)	AMI 1.1	Diamond 4.23	Award (September 1989)	AMI (May 1991)	
Flash memory		□	□	□	□	□	□	□	
Memory and Processor RAM Cache									
Installable RAM		1MB-32MB	4MB-64MB	8MB-64MB	1MB-64MB	1MB-32MB	4MB-32MB	4MB-64MB	
Cache controller		Intel	Club	Compaq	UMC	DFI	OPTi	Intel	
Installable RAM cache		128K	256K	256K	128K-256K	256K-1MB	256K	64K-128K	
Cache architecture		Direct-mapped	Direct-mapped	Two-way set-associative	Four-way set-associative	Direct-mapped	Direct-mapped	Four-way set-associative	
Cache write policy		Write-through	Write-back	Write-back	Write-back	Write-through	Write-back	Write-through	
Disk Drives									
Front-accessible drive bays		Two 5.25-inch, two 3.5-inch	Five 5.25-inch	One 5.25-inch, one 3.5-inch	Three 5.25-inch	Six 5.25-inch, five 3.5-inch	Three 5.25-inch, two 3.5-inch	Three 5.25-inch	
Internal drive bays		2	2	4	2	None	2	2	
Floppy disk drives		1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	
2.88MB floppy disk drive available		□	□	□	■	■	□	□	
Hard disk options		212MB-1.7GB	120MB-1.2GB	60MB-510MB	120MB-330MB	80MB-200MB	130MB-1GB	202MB-1.2GB	
Disk controller location		Card	Card	Motherboard	Card	Card	Card	Motherboard	
Expansion Bus									
8-bit slots		None	None	None	2	None	None	None	
16-bit slots		None	7	None	5	8	None	None	
32-bit EISA/MCA slots		8	None	5	None	None	7	7	
32-bit proprietary slots		None	1	2	1	None	3	1	
Parallel, serial, mouse ports on motherboard		None	None	1, 2, 1	1, 2, 0	None	None	1, 2, 1	
Video									
Display circuitry location		Card	Card	Card	Card	Card	Card	Card	
Video chip set manufacturer		S3	Tseng	Compaq	S3	Tseng	S3	S3	
Power Supply									
Power supply (watts)		250	250	240	200	200	230	300	
Number of device connectors		6	6	4	5	5	4	6	
Miscellaneous									
DOS 5.0		■	■	■	■	■	■	■	
Microsoft Windows 3.1		■	■	□	■	■	■	□	
Warranty		1 year	1 year	1 year	1 year	1 year	2 years	1 year	
First year on-site service charge		\$150	\$49	Included	Included	Included	Included	Included	
FCC Class B identification number		None	IP5-FALCON4	CNT75M7E9	I8HCOMPU4DX-50	E5QFTNMT486DX-50C	None	None	

N/A—Not applicable. The product does not have this feature. AIR—Advanced Integration Research, AST—AST Research Inc., ATI—ATI Technologies Inc., C&T—Chips & Technologies Inc., DFI—Diamond Flower International, SDC—Softworks Development Corp., SIS—Silicon Integrated Systems Corp., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Corp.

COVER STORY
50-MHz DX2s

Dataworld Data 486/DX2-50	Deico Predator 486DX2/50	Dell System 486D/50	Diamond DT 486DX2/50	Digital DECpc 452ST	Edge 486 DX2-50
\$2,675	\$3,135	\$3,018	\$2,199	\$5,400	\$2,899
212MB	200MB	240MB	202MB	852MB	240MB
Direct	Dealers, direct	Direct, superstores	Direct	Dealers, direct	Direct
Tower	Small-footprint	Small-footprint	Mini-tower	Mini-tower	Small-footprint
ISA	ISA	ISA	ISA	EISA	ISA

ELT	Deico	Dell	Dash	Intel	ECS
ETEQ, SIS	Symphony	VLSI	OPTi	Intel	UMC
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
□	■	□	□	□	□
□	■	■	□	■	□
AMI (May 1991)	AMI 1.1	Phoenix 1.10A07	AMI (June 1991)	Phoenix 1.00	AMI 1.1
□	■	■	□	■	□

1MB-64MB	1MB-64MB	4MB-64MB	1MB-64MB	4MB-192MB	1MB-64MB
ETEQ	Symphony	N/A	OPTi	Intel	UMC
64K-256K	128K	None	64K-256K	64K-128K	64K-256K
Direct-mapped	Direct-mapped	N/A	Direct-mapped	Two-way set-associative	Direct-mapped
Write-through	Write-through	N/A	Write-back	Write-through	Write-back

Three 5.25-inch, two 3.5-inch	Three 5.25-inch, two 3.5-inch	Three 5.25-inch	Three 5.25-inch, one 3.5-inch	Three 5.25-inch, one 3.5-inch	Three 5.25-inch
2	None	2	1	1	2
1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
■	■	□	■	□	□
212MB-500MB	80MB-200MB	50MB-1.4GB	202MB-1.5GB	105MB-852MB	80MB-1.2GB
Card	Motherboard	Motherboard	Card	Motherboard	Card

None	1	None	None	None	2
7	6	6	8	None	6
None	None	None	None	6	None
None	None	None	1	2	1
None	1, 2, 1	1, 2, 1	None	1, 2, 1	None

Card	Card	Motherboard	Card	Card	Card
S3	NCR	Paradise/WD	Tseng	WD	S3

230	200	224	200	254	200
5	6	5	5	6	7

■	■	■	■	■	■
■	■	■	■	■	□
1 year	1 year	1 year	15 months	1 year	1 year
Included	\$75	Included	\$75	Included	Included
None	HA3BA106030	E2K 486D	JHT83948650	EJMX86D56	H9NPCU486DX2-50

CONTINUES

Desktop for Windows 2.0, and your choice of one of several Borland or Lotus applications. This EISA-bus computer in a tower case, our Editors' Choice pick, has a lot going for it.

The BCM motherboard with Intel chip



set and AMI BIOS has a 256K direct-mapped write-through RAM cache with an Intel cache controller. The CPU plugs into a processor module card that fits into a proprietary motherboard slot, making CPU upgrades easy. Other slots include one 16-bit ISA slot and six 32-bit EISA slots. The maximum amount of RAM is 64MB. The video subsystem on our test unit consisted of a 14-inch MAG monitor with a 72-Hz refresh rate at 1,024-by-768 resolution and an ATI Graphics Ultra video card with 1MB of video RAM.

Performance scores for the Advantage were near the top of the pack on processor, memory, and DOS-based video tests. Its Graphics Winmark performance was outstanding: The ATI Graphics Ultra card produced the second-place score of 9.7 million. The 16-millisecond Quantum ProDrive LPS 240MB IDE hard disk with its own 256K disk cache was responsible for its above-average disk score.

The computer's rugged and spacious tower case facilitates adding hard disks. There are seven 5.25-inch drive bays, six of which can hold removable media. If you do add units, you'll find able assistance from the thorough and complete documentation.

Standard sells computers via mail-order, VARs, and OEMs. A two-year warranty on parts and labor is backed by on-site service from TRW. Technical support is available weekdays during business hours on a toll-free line.—BB

COVER STORY
50-MHz DX2s

► **S U M M A R Y O F F E A T U R E S**

In alphabetical order by company ■ = YES □ = NO	Eltech Model 4500 DX2	EPS 486-50DX EISA	Epson Equity 486DX2/50 Plus	Everex STEP 486DX2/50E	FutureTech System 452E	GRiD MFP/450	Hertz 486/D50X2e	
List price (PC Magazine configuration)	\$1,999	\$2,995	\$2,599	\$6,242	\$4,489	\$3,479	\$2,790	
Hard disk capacity	202MB	212MB	240MB	212MB	340MB	240MB	212MB	
Distribution channel	Dealers, direct	Direct	Dealers, direct	Dealers	Dealers, direct	Dealers, direct	Dealers, direct	
Case style	Small-footprint	Tower	Desktop	Desktop	Tower	Slimline	Desktop	
Bus architecture	ISA	EISA	ISA	EISA	EISA	ISA	ISA	
Motherboard								
Motherboard manufacturer	Eltech Research	Anigma	Epson	Everex	Mylex	Tandy	Hertz	
Chip set manufacturer	Symphony	Intel/Anigma	Epson	Intel	Intel	VLSI	ETEQ	
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	□ ■	□ □	■ ■	
ZIF (zero-insertion-force) socket	□	□	□	□	□	□	□	
Upgradable processor	■	■	■	□	□	■	■	
BIOS version (or date)	AMI (July 1991)	Award 4.28	C&T 2.1.03B	AMI (August 1991)	Diamond 2.31	Phoenix 1.10	AMI (July 1991)	
Flash memory	□	■	□	□	□	□	□	
Memory and Processor RAM Cache								
Installable RAM	4MB-64MB	4MB-64MB	4MB-16MB	4MB-64MB	1MB-96MB	4MB-32MB	1MB-32MB	
Cache controller	Symphony	Anigma	Intel	Everex	Intel	N/A	ETEQ	
Installable RAM cache	128K-256K	128K-256K	32K	256K	128K-512K	None	64K-256K	
Cache architecture	Direct-mapped	Direct-mapped	Two-way set-associative	Direct-mapped	Direct-mapped	N/A	Direct-mapped	
Cache write policy	Write-back	Write-through	Write-through	Write-back	Write-back	N/A	Write-through	
Disk Drives								
Front-accessible drive bays	Three 5.25-inch, two 3.5-inch	Four 5.25-inch, two 3.5-inch	Two 5.25-inch, one 3.5-inch	Five 5.25-inch	Five 5.25-inch	One 5.25-inch, one 3.5-inch	Three 5.25-inch, two 3.5-inch	
Internal drive bays	None	2	2	2	4	2	None	
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB	1.2MB, 1.44MB	
2.88MB floppy disk drive available	■	□	□	□	□	■	□	
Hard disk options	202MB-540MB	130MB-340MB	40MB-240MB	89MB-16GB	200MB-1.2GB	40MB-440MB	212MB-2GB	
Disk controller location	Card	Card	Motherboard	Card	Card	Motherboard	Card	
Expansion Bus								
8-bit slots	None	None	None	None	None	None	2	
16-bit slots	7	None	6	1	None	3	6	
32-bit EISA/MCA slots	None	8	None	6	8	None	None	
32-bit proprietary slots	1	None	1	1	None	None	None	
Parallel, serial, mouse ports on motherboard	None	None	1, 1, 1	1, 2, 0	None	1, 2, 1	None	
Video								
Display circuitry location	Card	Card	Motherboard	Card	Card	Card	Card	
Video chip set manufacturer	Tseng	Tseng	C&T	Tseng	S3	WD/Paradise	S3	
Power Supply								
Power supply (watts)	200	300	200	200	300	100	230	
Number of device connectors	4	5	5	4	6	3	5	
Miscellaneous								
DOS 5.0	■	■	■	■	■	■	■	
Microsoft Windows 3.1	■	■	■	■	■	■	■	
Warranty	1 year	1 year	1 year	1 year	15 months	1 year	1 year	
First year on-site service charge	Included	Included	Included	Included	\$79	\$79	\$75	
FCC Class B identification number	IOPERICOMP-425A	None	FDNT0340U	E3EEX-2600M-E1EL	None	G7W559-25	I3THERTZ4865	
N/A—Not applicable. The product does not have this feature. AIR—Advanced Integration Research, AST—AST Research Inc., ATI—ATI Technologies Inc., C&T—Chips & Technologies Inc., DFI—Diamond Flower International, SDC—Softworks Development Corp., SIS—Silicon Integrated Systems Corp., LMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Corp.								

COVER STORY
50-MHz DX2s



FACT FILE

Advantage 486 DX2/50

*Standard Computer Corp., 12803
Schabaram Ave., Irwindale, CA 91706; 800-
662-6111; fax, 818-960-2926*

List Price (Tested Configuration): \$3,275.

Memory and processor RAM cache: 8MB 70-ns. SIMMs, 256K cache.

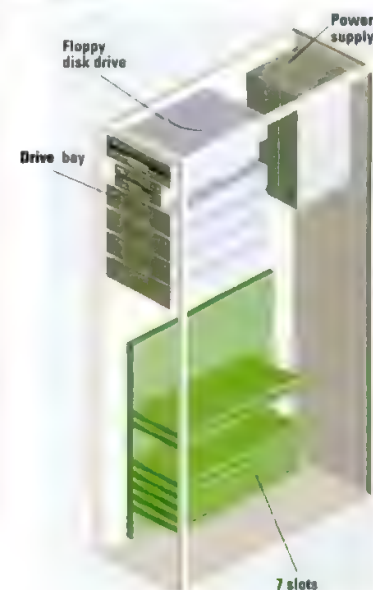
Disk drives and controller: Quantum 16-ms. 240 IDE hard disk, DTC controller, 256K cache, 1.2MB and 1.44MB floppy disk drives.

Display: ATI 1,280-by-1,024 adapter with 1MB RAM, MAG 14-inch monitor, 76-Hz refresh rate at 1,024-by-768.

Software: DOS 5.0, Microsoft Windows 3.1, Norton Desktop for Windows 2.0, HyperDisk; choice of Ami Pro, Freelance Graphics for Windows, Lotus 1-2-3 for Windows, Paradox, Turbo C++, or Turbo Pascal.

In Short: The Advantage 486 DX2/50 EISA tower is a good value; this \$3,275 PC comes with a strong software bundle and excellent performance.

ON READER SERVICE CARD



Swan Technologies Inc.

Swan 486DX2-50DB

Swan Technologies' entry for our 50-MHz DX2 roundup is a fairly priced \$3,495 system that is one of the first in this class of computers to deliver local-bus video. This small-footprint machine is based on a proprietary processor card with 32-bit local-bus video. The local-bus technology is

CONTINUES

HiQ 43FE	IBM PS/2 Model 95 XP 486 25/50	International Instrumentation Blue Max Monolith E486/500	Keydata 486-50 DX2 EISA Station	Leading Edge D4/DX2-50	Matrix 486-50 DX2
\$3,999	\$12,095	\$3,397	\$2,595	\$2,499	\$2,995
200MB	400MB	327MB	212MB	240MB	212MB
Direct	Dealers	Dealers, direct	Direct	Dealers, superstores	Dealers
Tower	Tower	Tower	Small-footprint	Small-footprint	Small-footprint
EISA	MCA	EISA	EISA	ISA	ISA

Free Technology	IBM	Mylex	ASUS	Daewoo	Micronics
Intel	IBM	Mylex	Intel	OPTi	Micronics, C&T
■ ■	□ □	■ □	■ ■	■ ■	■ ■
□	□	□	□	□	□
□	■	■	■	■	□
AMI (May 1991)	IBM (March 1992)	Mylex 6.14	Award 4.00	Phoenix (April 1990)	Phoenix (January 1988)
□	■	□	□	□	□

1MB-64MB	8MB-64MB	1MB-96MB	1MB-64MB	4MB-32MB	1MB-64MB
Free Technology	IBM	Discrete logic	Intel	OPTi	Micronics
64K-256K	512K	128K-256K	64K-256K	64K-256K	256K
Direct-mapped	Four-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Write-through	Write-through	Write-back	Write-through	Write-back	Write-through

Four 5.25-inch	Two 5.25-inch, three 3.5-inch	Four 5.25-inch	Two 5.25-inch, one 3.5-inch	Three 5.25-inch	Three 5.25-inch, two 3.5-inch
3	5	2	1	1	None
1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
■	■	□	□	□	■
200MB-535MB	160MB-1GB	40MB-2.2GB	212MB-340MB	130MB-340MB	40MB-2GB
Card	Card	Card	Card	Card	Card

None	None	None	None	None	None
None	None	None	None	8	8
8	8	8	8	None	None
None	2	2	None	None	None
None	1, 1, 1	None	1, 2, 0	None	None

Card	Card	Card	Card	Card	Card
S3	IBM	S3	S3	ATI	Tseng

250	195	250	200	200	200
4	3	6	4	4	5

■	□	■	■	■	■
■	□	■	■	■	■
2 years	1 year	1 year	18 months	1 year	1 year
\$75	N/A	Included	\$150	\$40	N/A
None	AN08595C50	DFK7CST14305	JTFDATA486S	C5F7NFCPC2000	None

All the power of a desktop. And a lot better mileage.

You've dreamed about a computer like this.

One that would have power and display capabilities equal to, or greater than, the desktop computer you're using now.

One you could take along to all of those different places you need to work.

One you wouldn't need a furniture dolly to move.

And here it is.

The Toshiba T6400.

With dimensions of 15.4" W x 10.5" D x 3.3" H (4.1" H with the color screen), it's small enough to fit in a briefcase.

With a spirited clock speed of

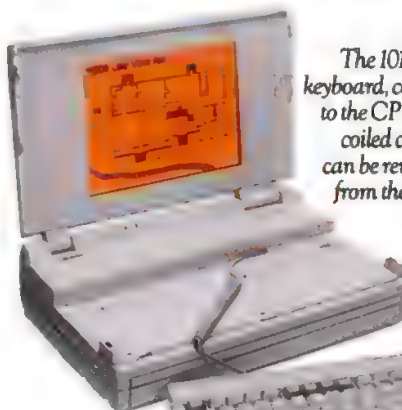
In addition to a 1.44MB floppy drive, you can choose a 120 or 200MB hard disk.



an impressive office building.

And if a combination like that doesn't make the T6400 portable better than the desktop computer you're currently using, we'll eat our collective hat.

This remarkable machine comes equipped with an internal 1.44MB, 3½" floppy drive and a



The 101-key keyboard, connected to the CPU by a coiled cord, can be removed from the case.

120 or 200MB hard disk. Plus 4MB RAM, expandable to 20MB. (Try finding any application that needs more memory than that.)

There's also a full-length, IBM-compatible, 16-bit expansion slot so you can take full advantage of your network card, SCSI controller or any of a myriad of other special purpose cards.

For even more expandability the T6400 comes complete with a 150-pin expansion port for direct input/output to the CPU, enabling you to connect storage and communications devices. Plus an internal dedicated

modem slot, as well as built-in parallel, serial, mouse and Super VGA video ports.

Depending on your particular needs, you can choose one of two display screens.

A state-of-the-art active matrix Super VGA color display with Thin Film Transistor technology, to deliver a higher quality image than you can get with most desktop monitors, and capable of displaying 256 simultaneous colors at 640 x 480 resolution.

Or a gas plasma display featuring 16 gray scales, also at 640 x 480 resolution, and a 100:1 contrast ratio—seven times the contrast of standard LCD displays, with ten times the display speed.

Both have a diagonal measure of 10.4" and provide simultaneous viewing capability with external Super VGA displays.



The AC-powered T6400 has full desktop expandability, including an IBM-compatible, 16-bit expansion slot.

To complete the T6400's amazing metamorphosis from desktop to portable, we took a 101-key keyboard



with full-size keys and key spacing, separate numeric keypad and eight dedicated cursor control keys, and nestled it into a compact 11.7 lb. package (12.9 lbs. with color screen). Then attached it to the CPU with a coiled cord, so you can remove

it and use it on your lap (or other convenient surface).

Now, having read all of the above, you'd probably welcome more information on the T6400. If so, call us at 1-800-457-7777.

The more you learn about our products the more you'll come to

understand the Toshiba philosophy: that portables are the future of personal computing.

Of course, with the introduction of the T6400 portable, it's a future that's already here.

In Touch with Tomorrow
TOSHIBA

CIRCLE 379 ON READER SERVICE CARD

COVER STORY
50-MHz DX2s

► **S U M M A R Y O F F E A T U R E S**

In alphabetical order by company ■ = YES □ = NO	Mega Impact 486DX2/50E	Micro Express ME 486-50/DX2	Micro Generation MG50DX2	National Micro Systems Flash 486DX2-50	NCR System 3335	NEC PowerMate 486/50i	NETiS EISA 450DX2
List price (PC Magazine configuration)	\$2,880	\$2,499	\$3,195	\$2,399	\$3,915	\$4,867	\$3,150
Hard disk capacity	340MB	240MB	212MB	212MB	212MB	240MB	212MB
Distribution channel	Dealers, direct	Direct	Dealers, direct	Direct	Dealers, direct	Dealers, superstores	Dealers, direct
Case style	Tower	Tower	Tower	Small-footprint	Slimline	Small-footprint	Small-footprint
Bus architecture	EISA	ISA	ISA	ISA	MCA	ISA	EISA

Motherboard

Motherboard manufacturer	BCM	Micronics	Continental	AIR	NCR	NEC	Free Technology
Chip set manufacturer	Intel	Micronics, C&T	OPTi	UMC, C&T	NCR	OPTi	Intel
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	□ ■	■ ■
ZIF (zero-insertion-force) socket	□	□	□	■	□	□	□
Upgradable processor	■	□	■	□	■	■	■
BIOS version (or date)	AMI (April 1991)	Phoenix 1.3	AMI (June 1991)	AMI 1.1	NCR 2.01	Phoenix 1.01	AMI (May 1991)
Flash memory	□	□	□	□	■	■	□

Memory and Processor RAM Cache

Installable RAM	4MB-64MB	4MB-64MB	1MB-32MB	4MB-64MB	4MB-192MB	4MB-36MB	4MB-64MB
Cache controller	Intel	Micronics	OPTi	UMC	N/A	OPTi	Discrete logic
Installable RAM cache	64K-256K	256K	64K-256K	64K-256K	None	64K-128K	1MB-256MB
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	N/A	Direct-mapped	Direct-mapped
Cache write policy	Write-through	Write-back	Write-back	Write-through	N/A	Write-back	Write-through

Disk Drives

Front-accessible drive bays	Four 5.25-inch	Eight 5.25-inch	Five 5.25-inch	Three 5.25-inch, one 3.5-inch	Two 3.5-inch	Two 5.25-inch	Three 5.25-inch, one 3.5-inch
Internal drive bays	4	2	2	1	1	2	1
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
2.88MB floppy disk drive available	■	□	□	■	□	□	□
Hard disk options	210MB-1.2GB	240MB-2GB	80MB-600MB	40MB-1.7GB	120MB-535MB	120MB-240MB	130MB-1.2GB
Disk controller location	Card	Card	Card	Card	Card	Motherboard	Card

Expansion Bus

8-bit slots	None	None	None	None	None	None	None
16-bit slots	1	8	8	8	None	4	2
32-bit EISA/MCA slots	6	None	None	None	8	None	6
32-bit proprietary slots	1	None	1	1	4	None	None
Parallel, serial, mouse ports on motherboard	None	1, 2, 1	None	None	1, 1, 1	1, 1, 1	None

Video

Display circuitry location	Card	Card	Motherboard	Card	Motherboard	Motherboard	Card
Video chip set manufacturer	S3	S3	S3	S3	NCR	Tseng	S3

Power Supply

Power supply (watts)	250	375	230	200	218	110	200
Number of device connectors	4	10	8	5	4	4	5

Miscellaneous

DOS 5.0	■	■	■	■	□	■	■
Microsoft Windows 3.1	■	■	■	■	□	■	■
Warranty	1 year	2 years	1 year	15 months	1 year	1 year	1 year
First year on-site service charge	N/A	\$50	\$57	\$50	\$40	\$38	\$60
FCC Class B identification number	None	GXUME48650	IZNSUREMAN48601	None	C6P-3432	B7ZEL486P	None

N/A—Not applicable. The product does not have this feature. AIR—Advanced Integration Research. AST—AST Research Inc., ATI—ATI Technologies Inc., C&T—Chips & Technologies Inc., DFI—Diamond Flower International, SDC—Softworks Development Corp., SIS—Silicon Integrated Systems Corp., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Corp.

COVER STORY
50-MHz DX2s

Northgate 486e	Novas Optimum 486 DX2-50	Osicom i450s	PC Brand 486/50 EISA Tower	Poly 486-50DX2	Sirius SST 486DX2-50MWC
\$3,749	\$2,845	\$2,295	\$4,095	\$3,400	\$2,800
240MB	240MB	200MB	212MB	212MB	212MB
Direct, company stores	Dealers, superstores	Dealers, direct	Direct	Dealers, direct	Dealers, direct
Small-footprint	Desktop	Small-footprint	Tower	Small-footprint	Desktop
EISA	EISA	ISA	EISA	EISA	EISA

TMC	Novacor	Osicom	PC Brand	Intercomp	SST
OPTi	OPTi	UMC	Intel	OPTi	Intel
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
□	□	□	□	□	□
■	■	■	□	■	■
AMI 2.0	AMI (July 1991)	AMI (July 1991)	PC Brand (March 1992)	AMI (July 1991)	Award 486 V4.0
□	□	□	□	□	□

4MB-128MB	4MB-256MB	4MB-32MB	4MB-64MB	4MB-128MB	2MB-32MB
OPTi	OPTi	Microcom	PC Brand	OPTi	SIS
256K	64K-512K	64K-256K	64K	256K-512K	64K
Direct-mapped	Direct-mapped	Four-way set-associative	Direct-mapped	Direct-mapped	Four-way set-associative
Write-back	Write-back	Write-through	Write-through	Write-back	Write-back

Three 5.25-inch, two 3.5-inch	Three 5.25-inch	Three 5.25-inch, one 3.5-inch	Six 5.25-inch	Three 5.25-inch, two 3.5-inch	Five 5.25-inch
1	2	None	2	None	None
1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
□	□	■	□	■	■
52MB-2.4GB	240MB-513MB	200MB-1GB	212MB-1.2GB	340MB-2.5GB	120MB-2GB
Card	Card	Motherboard	Motherboard	Card	Card

None	None	1	None	None	None
None	None	6	1	None	None
8	8	None	7	8	8
None	None	1	1	None	None
1, 2, 0	None	1, 2, 1	1, 2, 0	None	None

Card	Card	Card	Card	Card	Card
S3	S3	Trident	Tseng	S3	S3

200	230	200	300	230	200
5	5	4	5	4	5

■	■	■	■	■	■
■	□	■	■	■	■
1 year	2 years	1 year	1 year	2 years	1 year
Included	\$45	\$79	Included	\$75	Included
FHH-3XG-486ED	None	None	DFK7CST14700	None	None

CONTINUES



Swan's own but follows VESA's specifications for local-bus video mounted on the motherboard. As such, Swan's DX2 is an able platform for Windows and is optimized for graphics coprocessing by using the Sierra HiColor RAMDAC and the S3 chip for acceleration.

This standard ISA system comes with 4MB of RAM (64MB maximum), 128K of processor RAM cache, a 233MB

FACT FILE

Swan 486DX2-500B

Swan Technologies Inc., 3075 Research Dr., State College, PA 16801; 800-468-9044, 814-234-2236; fax, 814-237-4450

List Price (Tested Configuration): \$3,495.

Memory and processor RAM cache: 4MB 80-ns. SIMMs, 128K cache.

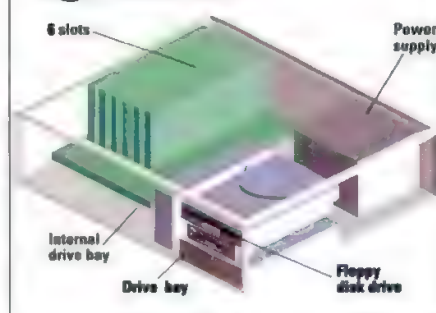
Disk drives and controller: Hewlett-Packard 13-ms. 233MB IDE hard disk, Cirrus controller, 64K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Swan 1,024-by-768 local-bus adapter with 1MB RAM, Swan 15-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1, Microsoft Works for Windows, Quicken for Windows, WealthBuilder.

In Short: The Swan 486DX2-500B's local-bus video technology is a step in the right direction, but the test unit did not live up to its promised performance potential.

ON READER SERVICE CARD



COVER STORY
50-MHz DX2s

► **S U M M A R Y O F F E A T U R E S**

									
In alphabetical order by company ■ = YES □ = NO	Softworks Citrus MDC	Spear 486 Convertible	Standard Advantage 486 DX2/50	Swan 486DX2-50DB	Tangent Model 450ex	Tri-Win 486 DX2-50 EISA	Unisys PW ² 4506 Advantage	United Micro UM Galaxy 450-DX2	
List price (PC Magazine configuration)	\$2,430	\$2,235	\$3,175	\$3,375	\$4,335	\$2,795	\$4,295	\$2,388	
Hard disk capacity	202MB	245MB	240MB	233MB	212MB	212MB	244MB	212MB	
Distribution channel	Dealers	Direct	Dealers, direct	Direct	Dealers, direct	Dealers, direct, company stores	Dealers, direct	Direct	
Case style	Small-footprint	Tower	Tower	Small-footprint	Mini-tower	Tower	Desktop	Small-footprint	
Bus architecture	ISA	ISA	EISA	ISA	EISA	EISA	ISA	ISA	
Motherboard									
Motherboard manufacturer	SDC	Quickpath	BCM	SCI	Mylex	Free Technology	Unisys	Pohai	
Chip set manufacturer	UMC	OPTi	Intel	Syscon	Intel	Intel	C&T	OPTi	
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
ZIF (zero-insertion-force) socket	□	■	□	□	□	□	□	■	
Upgradable processor	■	■	■	■	□	■	■	■	
BIOS version (or date)	AMI (July 1991)	Pixel Engineering 1.3	AMI 1.01	AMI (September 1989)	Mylex 6.0	AMI (May 1991)	Phoenix 1.01	AMI (June 1991)	
Flash memory	□	□	□	□	□	□	□	□	
Memory and Processor RAM Cache									
Installable RAM	1MB-32MB	1MB-32MB	8MB-64MB	4MB-64MB	4MB-32MB	4MB-64MB	4MB-64MB	1MB-64MB	
Cache controller	UMC	OPTi	Intel	Syscon	Mylex	Discrete logic	N/A	OPTi	
Installable RAM cache	64K-256K	64K-256K	256K	128K	128K	256K	None	64K-256K	
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	N/A	Direct-mapped	
Cache write policy	Write-back	Write-back	Write-through	Write-back	Write-back	Write-through	N/A	Write-back	
Disk Drives									
Front-accessible drive bays	Three 5.25-inch, two 3.5-inch	Four 5.25-inch	Six 5.25-inch	Three 5.25-inch	Three 5.25-inch, two 3.5-inch	Four 5.25-inch	Three 5.25-inch, one 3.5-inch	Three 5.25-inch, one 3.5-inch	
Internal drive bays	2	3	1	1	2	4	1	1	
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	
2.88MB floppy disk drive available	□	■	■	□	■	□	□	□	
Hard disk options	40MB-1.6GB	120MB-520MB	240MB-535MB	50MB-1.6GB	210MB-1GB	80MB-1.7GB	52MB-338MB	40MB-1.7GB	
Disk controller location	Card	Card	Card	Motherboard	Card	Card	Card	Card	
Expansion Bus									
8-bit slots	2	None	None	None	None	None	None	1	
16-bit slots	5	8	1	6	None	2	6	7	
32-bit EISA/MCA slots	None	None	6	None	8	6	None	1	
32-bit proprietary slots	None	None	1	1	None	None	None	None	
Parallel, serial, mouse ports on motherboard	None	None	None	1, 2, 0	None	None	1, 2, 1	1, 2, 1	
Video									
Display circuitry location	Card	Card	Card	Card	Card	Card	Motherboard	Card	
Video chip set manufacturer	WD	S3	ATI	S3	S3	S3	ATI	Tseng	
Power Supply									
Power supply (watts)	300	250	250	200	300	230	200	200	
Number of device connectors	6	5	6	5	4	8	5	4	
Miscellaneous									
DOS 5.0	□	■	■	■	■	■	□	■	
Microsoft Windows 3.1	□	■	■	■	■	■	■	■	
Warranty	1 year	1 year	2 years	2 years	1 year	2 years	1 year	2 years	
First year on-site service charge	\$65	Included	Included	Included	Included	Included	Included	N/A	
FCC Class B identification number	None	IBD48650U	F54STD486X5VTP	HOYSWAN3486M-B	II7486E	JASTS486-25SXIT	HXZMPI4XX61	None	

N/A—Not applicable. The product does not have this feature. AIR—Advanced Integration Research, AST—AST Research Inc., ATI—ATI Technologies Inc., C&T—Chips & Technologies Inc., DFI—Diamond Flower International, SDC—Softworks Development Corp., SIS—Silicon Integrated Systems Corp., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Corp.

USA Flex 486DX2/50 System	Wyse Decision 486/50 DX2	Zeos 486DX2-50
\$2,469	\$2,999	\$2,890
200MB	200MB	212MB
Direct	Dealers	Direct
Small-footprint	Desktop	Desktop
ISA	ISA	ISA

Cache	Wyse	Zeos
UMC	OPTi	VLSI
■ ■	■ ■	■ ■
□	□	□
□	■	■
AMI (July 1991)	Phoenix/Wyse (March 1991)	Award 3.1
□	□	□

4MB-32MB	2MB-32MB	1MB-96MB
UMC	OPTi	Intel
64K-256K	128K	128K
Direct-mapped	Direct-mapped	Four-way set-associative
Write-back	Write-through	Write-through

Three 5.25-inch, two 3.5-inch	Three 5.25-inch	Two 5.25-inch, two 3.5-inch
1	1	3
1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
□	■	■
40MB-425MB	110MB-200MB	80MB-1.1GB
Motherboard	Card	Motherboard

None	2	1
7	6	7
None	None	None
1	None	None
1, 2, 0	None	1, 2, 0

Card	Card	Card
S3	Tseng	S3

200	200	200
5	4	7

■	■	■
■	■	■
1 year	1 year	1 year
Included	\$99	\$49
None	DYDWWY4025	BYDPCT486DT

ENDS

Hewlett-Packard hard disk, two floppy disk drives, and a Swan Super VGA display. Aside from DOS 5.0 and Microsoft Windows 3.1, Swan bundles Microsoft Works for Windows 2.0, Quicken for Windows, and WealthBuilder financial planning software with its DX2, a strong combination that seems targeted to the home user.

For a small-footprint machine, the Swan offers acceptable expansion possibilities. It has one proprietary slot for the 32-bit processor card and six ISA slots (five were empty). The four drive bays consist of three accessible 5.25-inch drive bays and one 3.5-inch internal. The unit's most expansive feature, however, is the proprietary 32-bit processor card.

Our tests show that the Swan doesn't maximize its local bus video technology, though, finishing ninth overall and behind several S3 systems without local buses. A Swan spokesperson said that the company has improved the video performance since we tested their PC, incorporating an S3 part specially designed for local-bus designs, as well as providing more robust Windows 3.1 drivers. Its processor and memory performance (which relied on a 128K cache managed by a Syscon SC82C348 controller), as well as its hard disk performance with a 233MB Hewlett-Packard hard disk, was average.

Swan covers its DX2 with a two-year warranty on all parts and labor. On-site service from TRW is free the first year; after that an extended contract costs \$229 a year. The company's toll-free line handles all customer service requests and technical questions 24 hours a day; after normal business hours, inquiries are handled on a call-back basis.—GP

Tangent Computer Inc. Tangent Model 450ex

The Tangent Model 450ex proves that Tangent Computer knows how to flex its muscles. All you need (besides the 486



DX2 processor) is a Windows accelerator on your video card and a processor on your disk controller. A fast system doesn't always give you the best value for your money, though.

The \$4,495 machine tested by PC Magazine Labs came with 8MB of RAM (32MB maximum) and a 128K

direct-mapped cache, a 212MB hard disk and Mylex caching disk controller, a 1,024-by-768 Diamond Stealth VRAM S3-accelerated video adapter, and a Sampo 14-inch 72-Hz color monitor. For

FACT FILE

Tangent Model 450ex

Tangent Computer Inc., 197 Airport Blvd., Burlingame, CA 94010; 800-466-3300, 415-342-9388; fax, 415-342-9380

List Price (Tested Configuration): \$4,495.

Memory and processor RAM cache: 8MB 80-nb. SIMMs, 128K cache.

Disk drives and controller: Western Digital 14-ms. 212MB SCSI hard disk, Mylex controller, 4MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond 1,024-by-768 adapter with 1MB RAM, Sampo 14-inch monitor, 72-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: Tangent offers great performance and roomy EISA expansion at a higher-than-most price.



a 4MB system, you would pay \$4,335.

The Tangent expands easily. Its 18.5-by-7-by-18.5-inch tower case gives external access to three 5.25-inch and two 3.5-inch drives, and it has room for two internal 3.5-inch floppy disk drives. This PC also saves room by providing a dual 1.2MB and 1.44MB floppy disk drive in the top drive bay. Neither the eight EISA slots nor the eight SIMM sockets are hidden beneath the power supply.

Both the Tangent's processor and memory scores compared favorably with those of 486DX/50s previously tested by PC Labs. The combination of a Western Digital SCSI-2 hard disk and Mylex DCE376 disk controller, with its 4MB cache, gave this system a very high disk score, as well as contributed to the near-\$4,500 system price. For a server, this feature would be useful. For a standalone unit, however, you could use Windows 3.1's version of SmartDrive to achieve comparable performance on an uncached hard disk. Windows scores were above average but comparable to those of other systems that used the Diamond Stealth video card; its score on our DOS-based video was correspondingly low.

Tangent includes a one-year warranty and a year on-site service from TRW in the system's price. A toll-free technical support line is available weekdays during business hours.—JC

Tri-Star Computer Corp. Tri-Win 486 DX2-50 EISA

Tri-Star Computer Corp.'s Tri-Win 486 DX2-50 EISA includes a selection of components well-matched for high per-

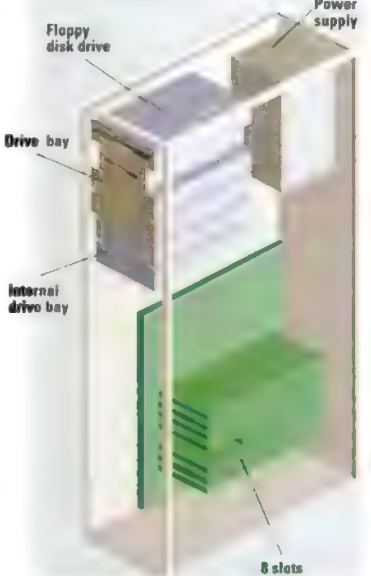


FACT FILE

Tri-Win 486 DX2-50 EISA
*Tri-Star Computer Corp., 120 S. Weber Dr.,
 Chandler, AZ 85226; 800-678-2799, 602-961-3401; fax, 602-961-4010*

List Price (Tested Configuration): \$2,795.
Memory and processor RAM cache: 4MB 70-ns. SIMMs, 256K cache.
Disk drives and controller: Maxtor 15-ms. 212MB SCSI hard disk, DTC controller, 2MB cache, 1.2MB and 1.44MB floppy disk drives.
Display: Diamond 1,024-by-768 adapter with 1MB RAM, MAG 14-inch monitor, 72-Hz refresh rate.
Software: DOS 5.0, Microsoft Windows 3.1.
In Short: The Tri-Win 486 DX2-50 EISA performed well on our benchmark tests, has room for eight drives, and comes with a two-year warranty.

 ON READER SERVICE CARD



formance. The tower we tested sells for \$2,795 and included 4MB of RAM, a 212MB hard disk with a 2MB disk cache controller, DOS 5.0, Microsoft Windows 3.1, and a three-button Logitech mouse.

The Tri-Win's Free Technology motherboard has an AMI BIOS, an Intel chip set, and a 256K direct-mapped buffered write-through RAM cache. RAM capacity in motherboard SIMM slots is from 4MB to 64MB. There are two 16-bit ISA slots and six EISA slots. Video for this system is provided by a MAG 1,280-by-1,024 14-inch 72-Hz multisynchronous monitor and a Diamond Stealth video card with an S3 video accelerator chip and 1MB of video RAM.

The 15-millisecond 212MB Maxtor LXT213S SCSI-2 hard disk and DTC disk controller with a 2MB disk cache helped the Tri-Win score among the top ten on our disk test; the 256K RAM cache contributed to high memory and processor scores as well. The Diamond Stealth video adapter was particularly speedy, as shown by the PC's Graphics Winmark score; its DOS-based video performance was characteristically average.

The Tri-Win's tower case has two cooling fans and nicely finished metal structural pieces inside. The case has eight drive bays: four accessible 5.25-inch drives and four internal (two 5.25-inch and two 3.5-inch).

Tri-Star sells via mail-order and has a company store; it offers a competitive two-year parts-and-labor warranty. On-site service from TRW is included the first year. Toll-free technical support is available six days a week.—BB

Unisys Corp. Unisys PW² 4506 Advantage

The \$4,495 Unisys PW² 4506 Advantage is a well-intentioned 486 DX2/50. The intelligently laid-out system board, the solid, full-featured unit, and the extensive documentation are what you would expect from a big-name computer manufac-



turer. But when it came to performance, this system was outclassed.

Look inside the unit and all the big names are there: A Unisys motherboard, Chips & Technologies chip set, Phoenix BIOS, and 240MB Quantum hard disk. What's missing, however, is what counts. Lack of a processor RAM cache resulted in processor and memory scores well in the bottom 20 percent. Unisys has put a

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CODE A4615

FACT FILE

Unisys PW² 4506 Advantage

Unisys Corp., P.O. Box 500, Blue Bell, PA
19424; 800-448-1424 ext. 161, 215-986-4011;
fax, 716-272-6671

List Price (Tested Configuration): \$4,495.

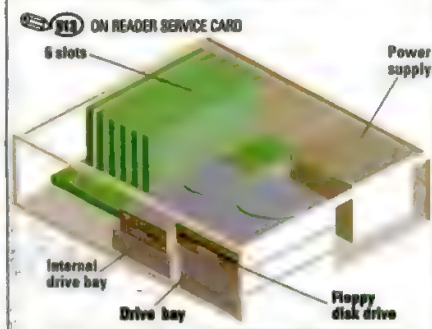
Memory and processor RAM cache: 8MB 70-ns SIMMs.

Disk drives and controller: Quantum 12-ms. 244MB IDE hard disk, Adaptec controller, 256K cache, 1.2MB and 1.44MB floppy disk drives.

Display: 1,024-by-768 adapter integrated onto motherboard, 512K RAM, Unisys 14-inch monitor, 72-Hz at 800-by-600.

Software: None.

In Short: The Unisys PW² 4506 Advantage is a machine with a lot going for it. Its potential is overshadowed, however, by disappointing performance.



non-local-bus ATI Direct Connect video chip set, which lacks a graphics accelerator, on the motherboard. The result was the familiar tradeoff: decent DOS video performance (fourteenth place) but an atrocious (dead last) Winmark Graphics score.

To its credit, the Unisys has ample room for expansion. The 8MB of RAM in our test unit can easily be upgraded to a maximum of 64MB on the motherboard. One parallel, two serial, and one mouse port are also located on the motherboard, leaving six full-size ISA slots invitingly open. Five drive bays (four out front and one internal) are easily accessible, but Unisys Corp. offers Seagate hard disks only in sizes up to 338MB.

Unisys sells this system via distribu-

tors, mail-order, and VARs, as well as through a corporate sales force, so don't expect much relief from the relatively high price tag. Included in the price are a one-year warranty on parts and labor, on-site service from Unisys itself, and toll-free technical support. Again, you would expect this level of service and support from an industry standard like Unisys. Unfortunately, there's little bang for the buck under the hood.—BG

United Micro

UM Galaxy 450-DX2

If up-front dollar cost is your first concern, look at United Micro's UM Galaxy 450-DX2. Although it isn't the fastest unit we tested, this PC's \$2,388 price buys you a DX2/50 with a 212MB hard disk and 4MB of RAM in a completely configured system. There's no on-site service, but if you want a DX2 and price is your ultimate consideration, this may be your next computer.

The small-footprint Galaxy case holds an ISA-bus Pohai motherboard with an AMI BIOS and an OPTi chip set. A 256K direct-mapped copy-back RAM cache works with an OPTi cache controller. The motherboard RAM maximum is 64MB. The tested system had an Addonics 14-inch 1,024-by-768 70-Hz Super VGA monitor; its Orchid ProDesigner IIs video card had a Tseng video chip set and 1MB of video RAM.

The Galaxy's performance scores were mixed. Helped by its 256K RAM cache, this PC's processor score was fairly high; the memory score was solidly average. Since the Tseng ET4000 series is DOS-oriented, the Galaxy's DOS-based video score was high, at the expense of its Graph-ics Winmark performance. Lacking an external disk cache, the 15-millisecond 212MB Maxtor LXT213IDE hard disk scored in the bottom of the group.

The Galaxy's small but sturdy case has neatly finished internal components and

good drive expansion for its size. Five bays hold three accessible 5.25-inch and one 3.5-inch units; the one internal bay holds a 3.5-inch drive. The motherboard has one 8-bit slot and seven 16-bit slots, two of which can take only half-length boards if the internal drive bay is used. On our test system, five slots were empty.

United Micro sells systems via mail-order. The standard service-and-support mix includes one year on parts and two

FACT FILE

UM Galaxy 450-DX2

United Micro, 6050 McDonough Dr., Suite
W, Norcross, GA 30093; 800-886-4833,
404-840-9250; fax, 404-840-9252

List Price (Tested Configuration): \$2,388.

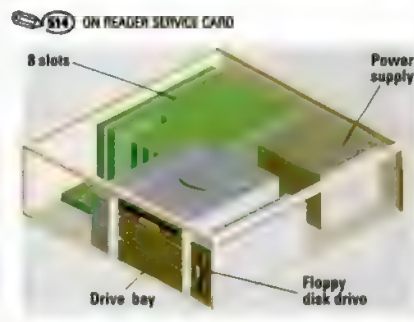
Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K cache.

Disk drives and controller: Maxtor 15-ms. 212MB IDE hard disk, 1.2MB and 1.44MB floppy disk drives.

Display: Orchid 1,024-by-768 adapter with 1MB RAM, Addonics 14-inch monitor, 70-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1.

In Short: While not a top performer and lacking on-site service, the UM Galaxy 450-DX2 is a price leader.



years on labor. An 800 line connects you to technical support during weekday business hours. No on-site service is available, but you could probably use the money you save with this system to purchase a local service contract, with cash to spare.—BB

USA Flex Inc.

Flex 486DX2/50 System

The USA Flex 486DX2/50 System is a bargain-priced mail-order unit in a small-footprint desktop case. For \$2,469, the Flex comes with 4MB of RAM, a 14-millisecond 200MB Western Digital IDE hard disk, Microsoft Windows 3.1, PC



The \$2,388 UM Galaxy 450-DX2



The \$2,469 Flex 486DX2/50 System

Test, PFS:WindowWorks, and a mouse. With midrange performance for this class and support that includes on-site service, the Flex is an excellent value.

Its ISA-bus motherboard, manufactured by Cache, has an AMI BIOS, a UMC chip set, and a 256K direct-mapped write-back RAM cache with a UMC cache controller. The computer supports up to 64MB of RAM: 32MB on the motherboard and 32MB more on a

memory expansion card. Video included a Diamond Stealth adapter with an S3 graphics accelerator, 1MB of video RAM, and a 14-inch MAG monitor with a 60-Hz refresh rate at 1,024-by-768 resolution.

The Diamond Stealth helped the Flex score fairly high on our Graphics Winmark test; since it was graphics-oriented, this card only managed an average score on our DOS-based video test. Processor, memory, and disk scores were all average.

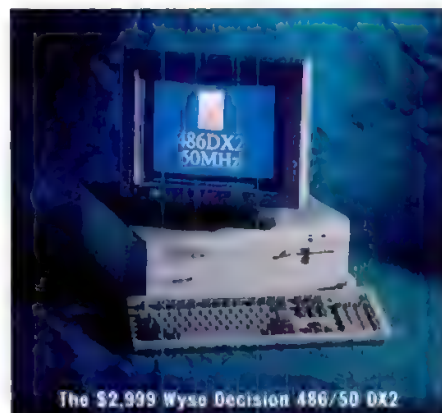
Inside, the Flex's small-footprint case looks a bit crowded, but everything fits, including full-height expansion cards. There are seven 16-bit ISA card slots, the seventh doubling as the 32-bit memory-card slot. Five of the six bays are accessible: three hold 5.25-inch units; two are for 1-inch-high 3.5-inch devices. The one internal bay holds a 3.5-inch drive.

Even at its relatively low price, the Flex 486DX2/50 System has a full set of user services. A one-year parts-and-labor warranty comes with free on-site service provided by Dow Jones. The toll-free technical support line is open 24 hours a day.—BB

Wyse Technology Inc.

Wyse Decision 486/50 DX2

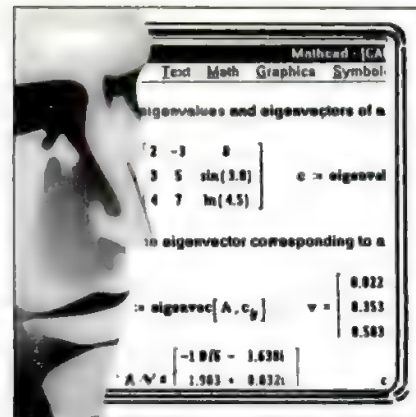
The Wyse Decision 486/50 DX2's quality is obvious—from the extra-sturdy case to the complete and well-written documentation. At \$2,999 with 4MB of RAM and a 200MB hard disk, the Wyse is fairly priced



The \$2,999 Wyse Decision 486/50 DX2

for this test group. Wyse Technology also sells to distributors and VARs, so keep your eyes open for even lower prices.

The Wyse's desktop case holds a Wyse ISA-bus motherboard with a Phoenix



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FACT FILE

Flex 486DX2/50 System
USA Flex Inc., 4711 Brighton Dr.,
Bloomington, IL 60108; 800-800-4395, 708-351-9700; fax, 708-351-7204

List Price (Tested Configuration): \$2,469
Memory and processor RAM cache: 4MB 70-ns SIMMs, 256K cache
Disk drives and controller: Western Digital 14-ms 200MB IDE hard disk, 1.2MB and 1 44MB floppy disk drives
Display: Diamond 1,024-by-768 adapter with 1MB RAM, MAG 14-inch monitor, 60-Hz refresh rate
Software: DOS 5.0, Microsoft Windows 3.1 and Microsoft Mouse, PC Test diagnostic software, PFS:WindowWorks.
In Short: The Flex 486DX2/50 System is an excellent bargain at \$2,469, and it does not compromise technical support and service

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COVER STORY
50-MHz DX2s

FACT FILE

Wyse Decision 486/50 DX2

Wyse Technology Inc., 3471 N. First St., San Jose, CA 95134; 800-438-9973, 408-473-1200; fax, 408-473-1972

List Price (Tested Configuration): \$2,999

Memory and processor RAM cache: 4MB 80-ns. SIMMs, 128K cache

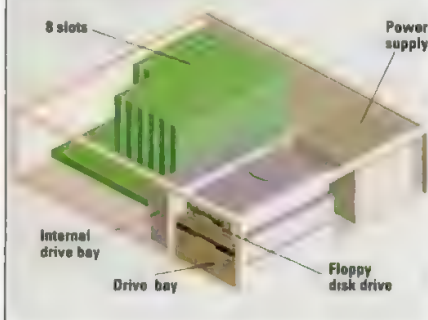
Disk drives and controller: Maxtor 15-ms 200MB IDE hard disk, Wyse controller, 1.2MB and 1.44MB floppy disk drives

Display: Wyse 1,024-by-768 adapter with 1MB RAM, Wyse 14-inch monitor, 60-Hz refresh rate

Software: DOS 5.0, Microsoft Windows 3.1

In Short: The Wyse Decision 486/50 DX2 is fairly priced for this class, and its quality is obvious

516 ON READER SERVICE CARD



ROM BIOS, an OPTi chip set, and a 128K direct-mapped write-through RAM cache with an OPTi cache controller. The RAM (2MB to 32MB) installs on the motherboard. The 14-inch Wyse monitor with 60-Hz 1,024-by-768 resolution is coupled with a Wyse video adapter and Tseng chip set; neither is maximized for graphics performance.

On our benchmark tests, this PC's video performance was typical for a card bearing the DOS-oriented Tseng ET4000 video chip set: It turned in a good DOS-based video score and a poor Graphics Winmark speed. The noncached 15-millisecond 200MB Maxtor LXT213 IDE hard disk performed a bit below the midmark of the test range; its processor and memory scores were solidly in the middle of the group.

The fine case has rugged support braces, and its design allows easy access for drive and card upgrading or service. There are three accessible 5.25-inch bays and one internal bay. Expansion cards can go into two 8-bit or six 16-bit slots, six of which were empty in our test system.

Wyse computers are sold via distributors and VARs. The standard warranty covers parts and labor for one year. InteLogic Trace handles on-site service for \$99 during the warranty period. Toll-free technical support is available during weekday business hours.—BB

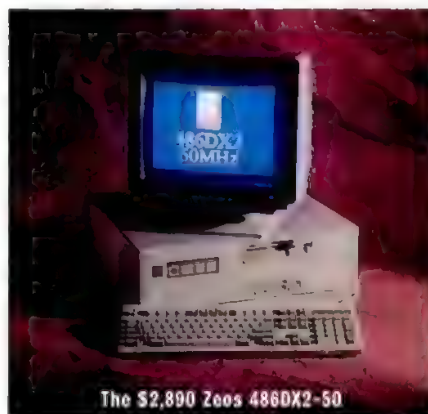
Zeos International Ltd.

Zeos 486DX2-50

You may not get the finest performance with the Zeos 486DX2-50, but this aggressively priced system continues the company's tradition of presenting enticing bargains in the latest processor class.

For \$2,890, the 50-MHz 486 DX2 comes with 4MB of RAM, a 212MB Western Digital Caviar IDE hard disk, and a Zeos Super VGA display subsystem that consists of a Diamond Stealth VRAM 1,024-by-768 adapter and a CTX-manufactured, Zeos-labelled color monitor. You can choose two of three Lotus applications—Lotus 1-2-3 for Windows, Freelance for Windows, or Ami Pro 2.0—in addition to the standard DOS 5.0 and Microsoft Windows 3.1.

Production values should never be left out of the buying decision, however. The CPU resides on a plug-in planar CPU card manufactured by PC Tech. Unfortunately, the company placed a vertical mount for an internal drive directly over the card, making upgrades difficult. We are also a little uneasy over the patch wires snaking across the CPU card. Nevertheless, the design of chassis allows seven full expansion slots, one 8-bit slot, and room for two accessible drives beyond the three installed. System memory tops out at 96MB, with 64MB on the motherboard and an additional 32MB of



The \$2,890 Zeos 486DX2-50

FACT FILE

Zeos 486DX2-50

Zeos International Ltd., 530 Fifth Ave. N.W., St. Paul, MN 55112; 800-423-5891, 612-633-5877; fax, 612-633-8296

List Price (Tested Configuration): \$2,890

Memory and processor RAM cache: 4MB 60-ns. SIMMs

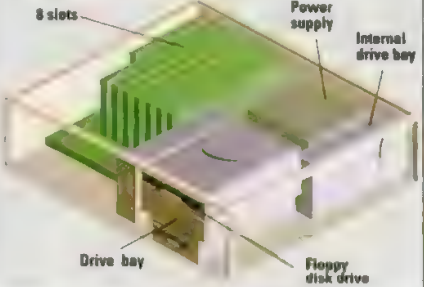
Disk drives and controller: Western Digital 14-ms 212MB IDE hard disk, VLSI controller, 64K cache, 1 2MB and 1.44MB floppy disk drives

Display: Diamond 1,024-by-768 adapter with 1MB RAM, Zeos 14-inch monitor, 60-Hz refresh rate.

Software: DOS 5.0, Microsoft Windows 3.1, WinRix, choice of two. Ami Pro 2.0, Freelance for Windows, or Lotus 1-2-3 for Windows

In Short: There is very little to distinguish this Zeos International system from the rest, other than the fact that it came with a plug-in 50-MHz DX2 processor card. Its performance is ordinary at best

517 ON READER SERVICE CARD



RAM residing on a memory card.

Although Zeos International offers a 128K processor RAM cache, the system tested here does not have one, which accounts for its low processor and memory scores. The performance of the generally dependable 212MB Western Digital Caviar IDE hard disk was also unexceptional. The display subsystem is another matter. A Diamond Stealth video adapter with its S3 graphics accelerator produced the expected boost in Windows performance along with a relatively poor DOS-based video score.

Zeos gives you a one-year warranty on its system but extends the coverage to five years on its keyboard. A first-year fee of \$49 buys you on-site service direct from the company; extensions cost 10 percent of the purchase price for each year up to four years. Technical questions and customer service calls are handled 24 hours a day on a call-back basis beyond normal business hours.—GP □

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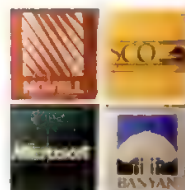
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DU100	Datapath Sw. Digital	64 Kbps	2-wire Sw. Digital	All Rates
DU170	Datapath Sw. Digital	64 Kbps	2-wire Sw. Digital	Keypad, Autodialer
TA120	Terminal Adapter	2 Ch. @ 64K 1 Ch. @ 16K	ISDN	Supports Voice & Data
TA/DL	Terminal Adapter	1 Ch. @ 64K 1 Ch. @ 16K	ISDN	X 25 PAD, Soft Upgrade
TA220	Terminal Adapter	2 Ch. @ 64K 1 Ch. @ 16K	ISDN	Combines "B" Channels
D56	DSU/CSU	56 Kbps	DDS	Low Cost 56K Sync.
DDS/MR1	DSU/CSU	56 Kbps	DDS	All DDS Rates
DDS/MR2	DSU/CSU	56 Kbps	DDS	DDS with Sec. Channel
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SERVER-MONITORING SOFTWARE:

Getting Inside Your File Server

These six server-monitoring software packages can ease fears about the health of your file server. But these programs have some serious limitations: They're better at warning you of danger than at helping you plan against it.

by Frank J. Derfler, Jr.

Quick: Is your server about to crash? If you're like most network administrators, there's probably no easy way to answer that question. Servers are like black holes; what goes on inside is mysterious and unknown.

At least until now. In the endless wave of network management tools, vendors are releasing software packages that give you a peek at the internal workings of your file server.

Taking a cue from capacity-planning tools on mainframes, these new management programs look at critical server statistics and warn you when parameters have been exceeded. Afraid of too few cache hits or running out of memory? No problem. These packages will not only notify you, they'll even page you if there's a problem.

In the following pages, we review six packages: LAN Server Watch, from Brightwork Development; NetAlarm and NetTrack, from Avanti Technology; NetVision, from Fresh Technology Co.; and NetWare Management and NetWare Early Warning System (both part of the Frye



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ILLUSTRATION BY ANTHONY RUSSO

Monitoring Software

Utilities for Networks), from Frye Computer Systems. These products range in price from \$325 per site license to \$1,495 for an enterprise license. All run under NetWare 2.x and 3.x. All can deliver a ream of server statistics.

We tested the products under Novell's flagship product, NetWare 3.11. What we found is surprising. Although all the vendors touted 3.x support, none of the products matched the capabilities they had under 2.x.

Avanti, Fresh, and Frye provide the strongest 3.x packages. But the Avanti and Fresh products still had problems under 3.11. A bug in Avanti's NLM (NetWare

Loadable Module) prevented it from noting a hard disk failure, a problem that the company says it has since corrected. Fresh's NetVision was unable to view information about certain server components.

NETWORK TOOLBOX

All of the packages reviewed here detect problems on the file server and notify you when those problems occur. Should disk capacity exceed a predefined threshold, for example, they'll alert you via a beeper or an e-mail message. The packages also report on server statistics over a period of time, so you can spot trends.

Novell's SYSCON and FCONSOLE management utilities report much of the same information as do the reviewed programs, but these utilities don't sift, quantify, or act on that data. You can't set alerts with SYSCON or FCONSOLE, nor can you view performance over time.

Though more useful than SYSCON or FCONSOLE, the reviewed server-monitoring packages come up short in the critical area of capacity planning, a feature long provided by mainframe management packages. Need to add 20 users to your network? None of the reviewed packages can help you anticipate the effect of such an expansion.

Because of this and other limitations, you'll need a bunch of tools and some insight into the workings of LANs to manage network growth. Server-monitoring software is merely one of the packages that helps you gather critical network information.

In addition to server-monitoring packages, your toolkit will require four other utilities: traffic counters, protocol analyzers, network inventory programs, and extended network management and control programs.

Traffic counters are relatively inexpensive applications that can set thresholds on low-level network parameters, such as the number of bad frames on the network. The prices for these packages range from about \$400 to \$2,000; Triticom's EtherVision (\$395) and TokenVision (\$495) are just two examples.

A superset of traffic counters, protocol analyzers not only monitor traffic levels, they also decode the contents of a frame and analyze its packets. These protocol analyzers are valuable for small amounts of data in specific environments. But the LAN adapters used with these products can lose packets in a busy environment, and the lower-cost programs don't handle the variety of data protocols found in specialized products, such as Network General Corp.'s Sniffer Network Analyzer (\$12,500) or the more advanced Expert Sniffer Network Analyzer (\$15,500).

Network inventory programs track the hardware and software on a LAN. These packages catalog the contents of a remote PC, retrieving information such as the interrupt levels, processor type, and memory and hard disk configuration. Some will also monitor the software on the PC.

HIGHLIGHTS

Server-Monitoring Software

WE TESTED SIX packages from four vendors that monitor NetWare 3.x file servers. Five provided adequate server management. Most are better suited to NetWare 2.x, primarily because Novell is still developing NLMs for NetWare 3.x.

NETWORK MANAGEMENT isn't just server monitoring. The other aspects of network management are traffic counting, protocol analyzing, network inventory, and extended network management and control.

MONITORING, ALARMS, reporting and notification are offered by all the reviewed packages. Among the programs we mention, only Knowzall Systems' File Wizard offers a macro language for responding to alerts. None of the reviewed programs enable you to predict the effect of additional users on the network. And they can't integrate server statistics with simple network management protocol (SNMP) information gathered from bridges, routers, wiring hubs, and other network devices.

THE NUMBER OF PARAMETERS monitored may not, by itself, provide a complete picture of a product, but it does give a good sense of how thorough the product's tracking is. Under NetWare 3.x, NetVision

monitored 24 parameters, NetAlarm monitored 22, NetWare Management monitored 12, EWS monitored 8, and LAN Server Watch tracked 6.

REMOTE-ALERT FEATURES are definitely hot. Frye Computer Systems and Brightwork Development can dial a pager to alert an off-site administrator of an emergency. Frye already ships a voice mail option, and other companies, such as Avanti Technology, are developing systems that program a digitized voice to "call" if server disaster is imminent; the manager can then respond to the crisis by making choices from a touch-tone menu.

PURCHASING CRITERIA for these packages should include the following considerations. First, the product should allow you to share the information with other management packages, since network management involves more than file-server monitoring.

The quality of the help screens is also significant. A good package will give you advice that is clear and thorough.

Auto-baselining is another important feature. This capability enables the package to determine a gauge for setting thresholds by averaging past server performance.

(For more information, see "LAN Inventory Software: Optimizing Network Resources," June 30, 1992.)

Extended network management and control applications, also called *management monitors*, collect network information from protocol analyzers and a wide variety of other sources, including wiring hubs, PCs, bridges, and routers. Currently, most of these management monitors use SNMP (the Simple Network Management Protocol), a standard protocol for communicating management information. Devices from different vendors can use SNMP to share management information.

In the future, management monitors will be able to use SNMP to gather information from network inventory and server-monitoring tools as well. By correlating the alerts sent by these tools, network managers will be able to plan network growth and oversee the network more effectively.

SERVER-MONITORING ARCHITECTURES

The server-monitoring packages in this review typically consist of two modules. The first is a statistics-gathering module—a value-added process (VAP) for a NetWare 2.x server or an NLM for a 3.x server. The second, *client* program enables the network manager to run the application. The VAP or NLM sends data on request to the program on the PC, which sorts, displays, and acts on the data. While VAPs and NLMs run only under NetWare, server-monitoring programs marketed by Banyan for VINES and by Microsoft for LAN Manager follow the same client/server architecture.

Much of the information returned under 3.11 by these packages hinges on the vendor's NLM. Without documented interfaces for the network operating system (NOS), vendors must probe the NOS on their own, searching for the needed data. Indeed, the products from Avanti, Fresh, and Frye were able to gather more information than the Brightwork package because of their superior NLMs.

Our Contributors: FRANK J. DERFLER, JR., is senior networking editor of *PC Magazine*. CAROL ELLISON, JONATHAN MATZKIN, and M. KEITH THOMPSON are frequent contributors to *PC Magazine*. PADRAIC R. BOYLE is senior networks analyst for Ziff-Davis Publishing Co. SUSAN G. THOMAS is an editorial researcher at *PC Magazine*. JEFFREY L. CARRELL is a senior communications systems engineer for a large transportation company.



EDITORS' CHOICE

Not just yet. Server management is important—very important. Your network, and maybe your business itself, depends on it. So choosing a

server-monitoring package is a crucial consideration for any network administrator.

With the exception of Brightwork's LAN Server Watch (LSW), the products we review provide much the same level of functionality. All but LSW can be used for managing a 3.x network, though not one of the 3.x packages can match LSW under 2.x.

There are other differences as well. Avanti Technology's NetAlarm and NetTrack and Fresh Technology Co.'s NetVision track more statistics than the Frye Utilities for Networks. But the Frye product and Brightwork's LSW provide more notification options than either the Avanti Technology or Fresh Technology packages.

These products are still maturing. LSW, for example, shows great promise with its NetWare 2.x support. But

without strong support for 3.11 statistics, the package has limited functionality. The Avanti Technology and Fresh Technology products lack some important notification options, while the Frye Utilities need greater statistical support.

The reviewed products need help in other areas as well. For starters, they should offer historical reporting by user, department, and group. Even more important is stronger statistical monitoring. No one product tracks all of the statistics you'll want to monitor for NetWare 3.x: NetAlarm and NetTrack, for example, are the only products to monitor CPU and memory utilization, but they won't track cache utilization or FAT errors. Finally, the packages need a scripting language so you can create set responses to recurring problems.

REVIEW CRITERIA

To qualify for this review, the monitoring programs had to report real-time and historical statistical information, such as CPU utilization or cache read/write errors, from a NetWare 2.x and 3.x server and take appropriate action based on that information.

Shany Computers' AlertVIEW was not reviewed because it's designed for managing applications running on networked PCs, not on a file server. The AG Group's NetWatchman is also inappropriate because it monitors Macintosh servers only. Microcom's LANlord monitors only workstations. And Cheyenne Software's Monitrix and Intel's NetSight Analyst are network monitoring packages, not server-specific packages.

Server-monitoring packages for VINES and LAN Manager networks are

also available. The third-party Banyan offerings include such products as BanScan, from TCE Technology Group; Exposé, from Trellis Software; and ServerWatch, from Datech Network Systems (see the sidebar "Banyan, Microsoft, and Novell: Server-Monitoring Software from the Source").

Another package that doesn't meet our review criteria is File Wizard, from Knowzall Systems. File Wizard provides extensive statistics for tracking disk usage and makes projections of disk utilization based on operational history; it even produces charts of extrapolated data. It does not monitor CPU utilization, however, nor does it offer many of the other statistics provided by the reviewed packages (see the sidebar "File Wizard Does Network File Housekeeping").

Another development in server monitoring comes from Loren Data Corp., a Los Angeles-based consulting firm that will monitor your server remotely and alert you by fax or pager when it spots a problem. (To date, Loren Data works with NEWS. You can reach Loren Data at 800-745-6736.)

NETWORKING

Monitoring Software

Suitability to Task: Server-Monitoring Software

The monitoring needs of network administrators vary according to the problems they typically encounter. While some networks gobble up hard disk space, others burden the print server or put too heavy a load on the file server's CPU. Use our Suitability to Task ratings to help you locate the best server-monitoring product for your NetWare 3.x network. Compare this chart with the product reviews and features table to get a better idea of the products' strengths and limitations.

Reporting and statistical analysis rates each package's ability to generate periodic reports, analyze server statistics, and form conclusions and recommendations for change. The program should be able to display data in an easy-to-understand way, either numerically, graphically, or both.

Hard disk monitoring measures each product's ability to monitor and to notify you of the server's fault tolerance features, such as disk mirroring and hot-fix tables, which indicate defective hard disk blocks. The product should list the mirrored groups, tell you if the mirrored drives are in sync and in working order, and report the size of each drive, the available drive space, and the names and number of volumes installed. It should also allow you to set thresholds.

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Reporting and statistical analysis	●	○	○	○
Hard disk monitoring	●	●	○	○
Network monitoring	●	●	●	○
User monitoring	●	●	●	●

N/A—Not applicable: The product does not perform this task.

Network monitoring rates each package's ability to monitor network throughput and identify network adapter and driver types. The product should provide information about each adapter's name, driver version, frame type (Token-Ring or Ethernet), default frame size, slot number, and interrupts. The product should also detect any configuration changes to the server's environment, as in the receive buffer setting, maximum physical receive packet size, receive packet overflow, and packets discarded.

User monitoring measures the product's ability to alert you of user lockouts, password violations, and off-hour log-ons. The package should let you set a threshold for the number of users connected and notify you when two stations have logged on to the server under the same user name. Good products can identify a station's address; the DOS, IPX, and shell versions; and the network adapter configuration. They also can track IPX node-to-node packet transmission and analyze users' file activity in detail, as well as compute how many packets a user has transmitted and received.

STATISTICAL DETAILS

For the most part, the six monitoring packages reviewed here give you information about your server's hard disk statistics, such as the raw amount and percentage of storage in use and the percentage of read requests satisfied from the disk cache. The server monitors also provide other information, however. Most of them also return data on CPU and memory utilization, which lets you analyze how heavily the file server is being used. These monitoring packages offer limited insight into the operation of the server hardware by presenting such statistics as CPU utilization.

Although the applications in this roundup track many important server statistics, they have a long way to go before they can challenge the proprietary applications offered on super servers from Compaq Computer Corp., Parallax

Computer, NetFRAME Systems, and Tricord Systems. These vendors provide internal hardware products that monitor minute operational details of the hardware—such as internal temperature and bus utilization—and take a variety of preprogrammed actions in response to certain conditions.

The Parallax Server 290, for example, now sold by IBM as the PS/2 Server 295, includes a Maximum Availability and Support System (MASS) that monitors voltage levels, memory failures, individual disk drives, and many other server-specific details to warn of failures. It can call managers and report specific problems, and lets the network manager control the file server by phone. A similar feature, Server Activation Maintenance (SAM), is part of the NetFRAME product. Best of all, these packages run on their own processors. So if the server crashes, these

products can continue to function. No mere software package, such as those reviewed in this roundup, can offer these capabilities.

MANAGEMENT KIT

Managing your server requires savvy and the right complement of tools. Server-monitoring programs fall short of the comprehensive capabilities offered by capacity-planning mainframe programs. But by keeping you posted on changing conditions and warning you of many impending difficulties, server-monitoring programs earn a place in your network toolkit.

Frye Computer Systems Inc.

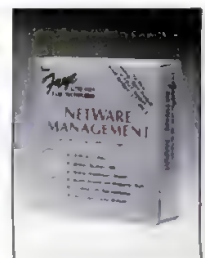
Frye Utilities for Networks:

NetWare Management

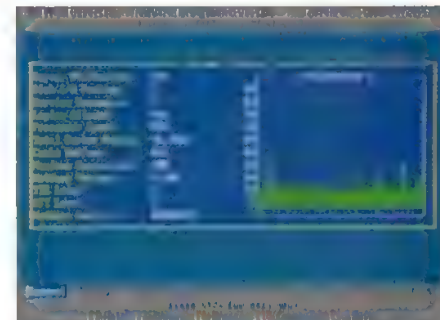
NetWare Early Warning System

BY PADRAIC R. BOYLE

Whether you're linked to it via electronic mail or telephone, Frye Utilities for Networks (FUN) will reach out and touch you. FUN, from Frye Computer Systems, provides the widest range of notification options among the reviewed products, along with a competitive array of troubleshooting features, including the ability to monitor an unlimited number of servers from one station. But with limited NetWare 3.1x support and a costly \$395 bill for each additional server (the first server costs \$495),



PRODUCT PHOTOS BY THOM C. CONVER



Frye Utilities for Networks' general information screen gives you some helpful data about your server, and it generates a real-time bar chart of the server utilization.

► SUMMARY OF FEATURES

Server-Monitoring Software

This table shows which products offer each of the most important server-monitoring statistics, notification methods, and reporting features. All the products in the review run under NetWare 2.x and 3.x; none support Banyan's VINES or Microsoft's LAN Manager.

None of the products provide bus-monitoring statistics, but all report on

the current number of connections to the server and the maximum number of simultaneous connections allowed. Boolean logic refers to the use of logical operators when setting thresholds.

For descriptions of the monitoring statistics and their purposes, see the table "NetWare Statistics and What They Mean."

Products listed in alphabetical order	Frye Utilities for Networks: NetWare Management	Frye Utilities for Networks: NetWare Early Warning System	LAN Server Watch	NetAlarm	NetTrack	NetVision
■ = YES □ = NO						
List price	First server, \$495; additional servers, \$395 each	First server, \$495; additional servers, \$395 each	\$695 per file server	\$495 per site	\$325 per site	Up to 8 file servers, \$695
Monitoring Statistics Supported (NetWare 2.x / 3.x)						
Cache hit rates	■ □	■ □	■ □	■ ■	■ ■	■ ■
Cache read and write errors	■ □	■ □	■ □	■ □	□ □	■ ■
Cache thrashing	■ □	■ □	■ □	■ □	□ □	■ ■
Cache utilization	■ □	■ □	□ □	■ ■	■ ■	■ ■
Directory entry usage by volume	■ □	■ □	■ ■	■ ■	■ ■	□ □
Disk channel failed	■ □	■ □	■ □	□ □	□ □	□ □
Disk I/Os pending	■ ■	□ ■	□ □	■ ■	■ ■	■ ■
Disk space by volume	■ ■	■ ■	■ ■	■ ■	□ □	□ □
Disk thrashing	■ □	■ □	□ □	■ □	□ □	■ ■
Disk utilization	■ ■	■ ■	■ □	■ ■	□ □	■ ■
Drive hot fix enabled	■ ■	■ ■	■ ■	■ ■	□ □	□ □
Drive mirror failed	■ ■	■ ■	□ □	■ □	□ □	□ □
Drive I/O errors	■ □	■ □	□ □	■ ■	□ □	□ □
FAT errors	■ □	■ □	■ □	■ □	□ □	■ ■
File server CPU utilization	□ □	□ □	■ □	■ ■	■ ■	■ ■
Incoming or outgoing packet discarded	■ □	■ □	■ □	■ □	■ □	□ □
Incoming or outgoing packet lost	■ □	■ □	□ □	■ □	■ □	□ □
IPX node-to-node testing	□ □	□ □	□ □	□ □	□ □	■ ■
LAN I/O	■ ■	□ □	□ □	■ ■	■ ■	□ □
Login disabled	■ ■	■ ■	■ ■	□ □	□ □	□ □
Maximum and current Bindery objects	■ □	■ □	■ □	■ □	□ □	■ ■
Maximum and current dynamic memory	■ □	■ □	■ □	■ □	■ ■	□ □
Maximum and current files open	■ ■	■ □	■ □	■ ■	■ ■	■ ■
Maximum and current indexed files	■ □	■ □	■ □	□ □	□ □	■ ■ (maximum only)
Maximum and current routing buffers	■ □	■ □	■ □	■ ■	■ ■	■ ■
Maximum and current transactions	■ □	■ □	□ □	□ □	□ □	□ □
Memory utilization	■ ■	■ ■	■ □	■ ■	■ ■	□ □
Printer off-line	■ □	■ □	□ □	□ □	□ □	□ □
Server not responding	■ ■	■ ■	■ ■	■ ■	■ ■	□ □

CONTINUES

► SUMMARY OF FEATURES

Products listed in alphabetical order	Frye Utilities for Networks: NetWare Management	Frye Utilities for Networks: NetWare Early Warning System	LAN Server Watch	NetAlarm	NetTrack	NetVision
■ = YES □ = NO						
Monitoring Statistics Supported (NetWare 2.x/3.x)(continued)						
Server utilization	■ ■	■ ■	■ □	■ ■	■ ■	■ ■
Transaction tracking disabled	■ ■	■ ■	■ ■	■ ■	□ □	□ □
TTS backout request(s) failed	■ □	■ □	□ □	□ □	□ □	□ □
Notification Methods Supported						
NetWare message	□	■	■	■	□	■
MHS message	□	■	■	□	□	□
Pager message	□	■	■	□	□	□
cc:Mail message	□	■	■	□	□	□
Fax message	□	■	□	□	□	□
Incoming and outgoing voice messages	□	Optional (\$3,300)	□	□	□	□
Alarms set by average	□	Optional (\$295)	□	■	□	□
Alarms triggered by exact match	□	Optional (\$395)	■	■	□	□
Boolean Logic Supported						
AND	□	□	□	□	□	□
OR	□	□	□	□	□	□
>	□	□	■	■	□	■
<	□	□	■	■	□	■
=	□	□	■	■	□	□
> or =	□	□	□	□	□	□
< or =	□	□	□	□	□	□
If-then	□	□	□	□	□	□
Exporting Capabilities						
ASCII	■	■	■	■	■	■
dBASE	■	■	□	□	□	□
Lotus 1-2-3	□	□	□	□	□	■
.PCX	□	□	□	□	□	■
Miscellaneous						
Auto-baselining (derives a baseline automatically)	□	Optional (\$295)	□	■	■	□
Software and hardware inventory	□	□	□	□	□	■

ENDS

FUN is certainly not a perfect solution.

FUN consists of three separately priced packages: the two we review here—NetWare Management, Version 1.11B, and NetWare Early Warning System (EWS, formerly known as NEWS), Version 1.1—and Frye's network inventory program, LAN Directory (reviewed in "LAN Inventory Software: Optimizing Network Resources," June 30, 1992).

NetWare Management is Frye's

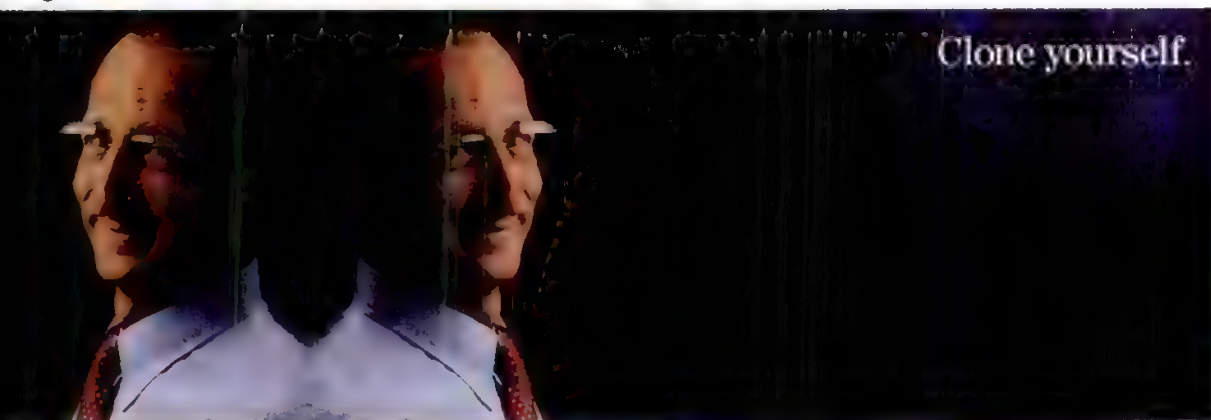
troubleshooting package. This simple-to-use tool displays detailed information about your network's resources, users, server configuration, and print servers. It enables you to locate bottlenecks by providing a real-time overview of server components and network performance, including bridges and routers.

EWS provides FUN with alerting capabilities, and you can set thresholds to track eight server parameters for

NetWare 3.1x. NetWare 2.x is more widely supported, with support for up to 28 statistics. When a threshold is exceeded, EWS alerts you via an electronic pager (if you have a Hayes-compatible modem), MHS (Message Handling Service) for e-mail, or the Novell Send command; it can also trigger a DOS batch file to perform unattended operations.

Optional notification features include the Alpha Pager (an alphanumeric pager

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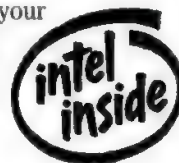
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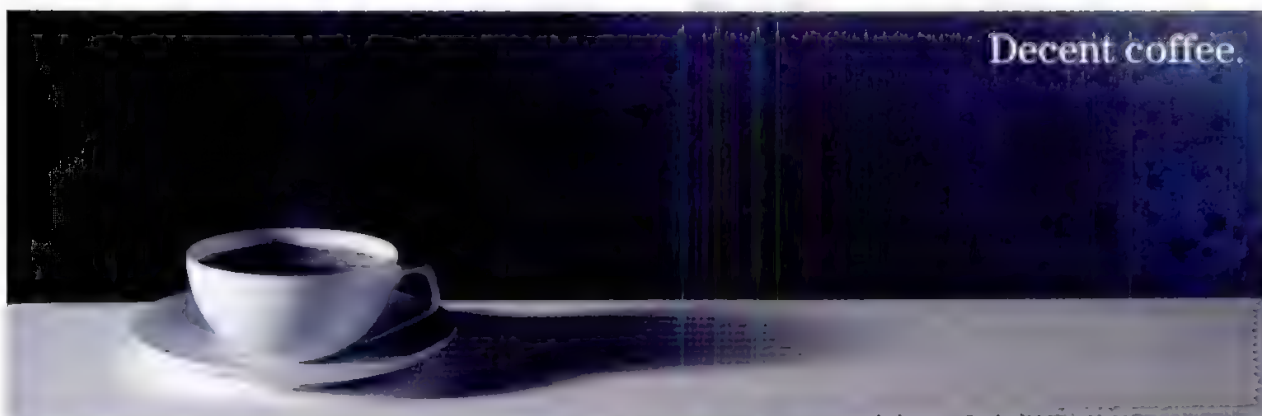
**HEWLETT
PACKARD**

NetWare Statistics and What They Mean *by Jeffrey L. Carrell*

Server monitors track many activities. Those marked 1 are most useful for troubleshooting or performance; 2s are also important, but not to the same extent.

Type of server activity	Area affected	Usefulness:		Explanation	Suggested resolution for the problem
		Troubleshooting	Performance		
Cache hit	Disk	2	1	How many times a read or write of a disk block of data is in cache memory.	Helps in performance tuning; not necessarily indicative of a problem.
Cache miss	Disk	2	1	How many times a read or write of a disk block of data is not in cache memory.	Allocate more server memory to the cache buffer if misses are excessive
Cache read/write errors	Disk	2	1	How many disk errors are reported after cache asks driver to perform a read or write.	If multiple errors are reported, drive may need to be replaced soon.
Cache thrashing	Disk	—	1	A cache block could not be allocated because all are currently in use.	Add more memory or reduce file server load to avoid serious performance loss.
Cache utilization	Disk	2	1	Percentage of disk block of data that is in cache memory.	If less than 90 percent, add memory or reduce the number of mapped drives.
Directory entry usage by volume	Disk	2	1	Should show maximum, peak, and current number of directory entries available.	If usage exceeds 75 percent of the volume, back up and delete old files.
Disk channel <i>n</i> failed	Disk	1	—	Netware file servers can have up to 5 channels. Error can occur at boot time or when SFT (System Fault Tolerance) Level II detects a mirrored drive failure	Turn server off and then back on. If problem persists, replace the controller and, if necessary, the drive
Disk device <i>n</i> deactivated	Disk	1	—	The device is typically the controller. Error message can appear while server is running or when SFT Level II detects a mirrored drive-channel failure.	Turn off server and any external drive subsystems. Then turn them back on. If the problem persists, replace the controller and, if necessary, the drive.
Disk I/Os pending	Disk	2	1	Number of disk accesses (requests for reads or writes) pending	If number is excessive, you need a faster controller, more drives or servers, or more memory for caching
Disk space by volume	Disk	2	1	The total disk space and hot-fix area available before data loading.	Helps in performance tuning; not necessarily indicative of a problem.
Drive <i>n</i> hot fix enabled/disabled	Disk	1	—	The drive's hot fix is turned on, hot fixes are not supported, or the hot-fix area is filled up.	Back up drive, reenable hot fixes, and restore files to the drive.
Drive <i>n</i> hot fix used XX% of total	Disk	2	1	If hot-fix area fills up, drive may not accept more data.	Back up data, run COMPSURF utility to reformat the drive; if reformatting doesn't work, replace the drive
Drive <i>n</i> mirror failed	Disk	1	—	A serious problem with one of the two disks. SFT continues with one drive only.	Turn off the server. Check controller, drive, and cable to see if they need replacing. When server boots, remirror the drive
FAT errors	Disk	1	2	Errors during a write to the File Allocation Table.	Turn server off and then back on. Answer yes if prompted. Let server replace the current FAT with the backup FAT.
File server boot time and date/up-time	File server	1	2	Shows when server was last booted and how long it has been up	Helps in performance tuning; not necessarily indicative of a problem
File server CPU utilization	File server	2	1	Should show current, average, and maximum percentage of CPU utilization.	The CPU may need to be upgraded if the average rate is too close to the peak
Incoming/outgoing packet discarded	Network card	2	1	Packet is discarded if it has crossed 16 bridges or routers or if its destination is unknown.	Use a protocol analyzer to view traffic. You may need to replace such components as the adapters or ports, or change the topology if the network is overextended.
Incoming/outgoing packet lost	Network card	1	2	A Packet cannot be received because the server is out of communication buffers.	Add buffers or more RAM to the server.
IPX node-to-node testing	Network card	1	2	Tests whether IPX (Internet Packet Exchange protocol) communication works between stations	Helps in performance tuning; not necessarily indicative of a problem Also used to test newly built LANs
LAN I/O	Network card	2	1	Information includes packets received, transmitted, and routed; NetBIOS broadcasts; and so forth.	Helps in performance tuning, not necessarily indicative of a problem
Login disabled	Operating system	1	—	Helps the supervisor perform system-level maintenance.	Helps in performance tuning; not necessarily indicative of a problem
Maximum/peak/current:					
Bindery objects	Operating system	2	1	Information includes user IDs, passwords, trustee assignments, group IDs, and server names. Helps in tracking object limits.	If maximum limit is exceeded, upgrade drive/memory, reduce server load, or add new server.
Connections	Operating system	2	1	Users and network services (print and fax servers) connected. Helps in tracking user-to-server utilization.	If maximum limit is exceeded, upgrade drive/memory, reduce server load, or add new server.
Dynamic memory	Operating system	2	1	How much RAM is used for operating-system components. Helps in tracking file-server memory utilization when adding RAM.	If maximum limit is exceeded, upgrade memory, reduce server load, or add new server.
Files open	Operating system	2	1	Too many open files may affect server performance.	If maximum limit is exceeded, upgrade drive/memory, reduce server load, add new server, or increase Files Open limit
Indexed files	Operating system	2	1	Useful for 1MB files or larger. Reads file location data from disk into memory	If maximum limit is exceeded, upgrade drive/memory, reduce server load, add new server, or increase comm buffer limit.
Routing buffers	Operating system	2	1	Allows the storage of incoming and outgoing packets.	If maximum limit is exceeded, upgrade drive/memory, reduce server load, or add new server
Transactions	Operating system	2	1	Number of concurrent transactions. The limit is set on initial installation.	If maximum limit is exceeded, upgrade drive/memory, reduce server load, or add new server.
Printer off-line	File and print server	1	—	Printer is either off-line or responding improperly.	Check printer and connection.
Server not responding	File server	1	—	Client PC can't communicate with server	Problem with LAN card, driver, or cable Replace each in turn to see which does not work
Transaction-tracking status	File server	1	—	NetWare database function that copies changed records to a backup file and records the recovery and backup scheme. Status is enabled or disabled	Enable TTS.
TTS backout request(s) failed	File server	1	—	NetWare's transaction-tracking status backout procedure automatically returns you to the previous server entry	Failure means loss of data. Next time, enable TTS or increase disk space.

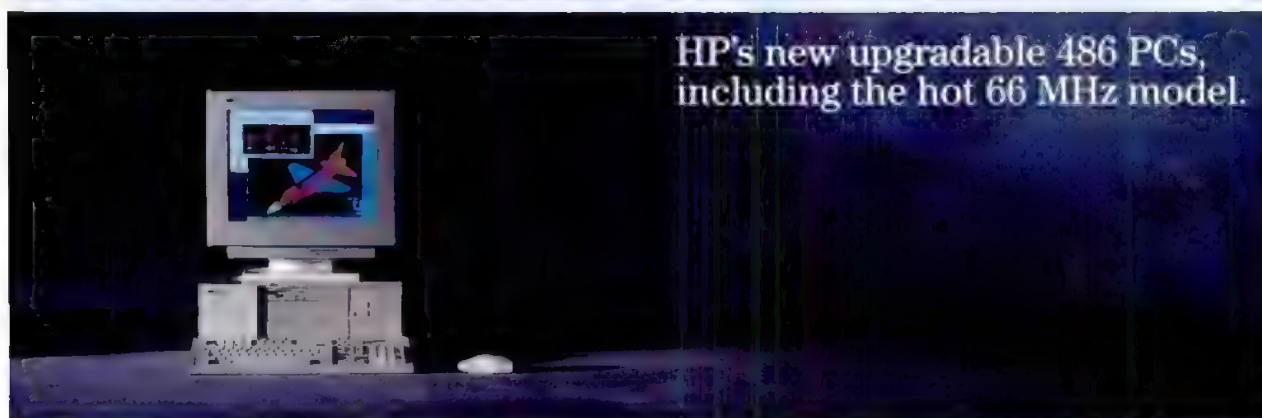
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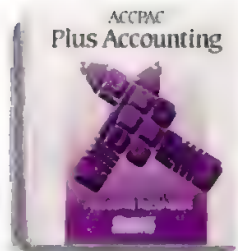
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■ Banyan, Microsoft, and Novell: Server-Monitoring Software from the Source

M. Keith Thompson and
Susan G. Thomas

The monitoring applications offered by the major NOS (network operating systems) vendors are a motley crew indeed. Banyan's VINES Assistant lets you set thresholds and alarms, but the program is more difficult to use and less comprehensive than those in the main roundup. Microsoft splits monitoring management between two packages. One of them doesn't monitor nearly the number of statistics as do the third-party packages we review; the other is really a Visual Basic programmer's kit. Novell's offerings range from the comprehensive but expensive (\$4,995) NetWare Services Manager to the free but skimpy STAT.NLM and DUMPSTAT.EXE.

But before you discount these packages altogether, read over our summaries below.

BANYAN

• VINES Assistant (\$699)

VINES Assistant is a set of VINES network-management utilities for on-line diagnostics, performance tuning, and troubleshooting; you can also set alarms and thresholds. It addresses four different areas: Historical Performance Analysis, Service Configuration Management, Administrative Utilities, and Console Diagnostics. Most of these tools focus on network management, not server monitoring. The graphs produced by VINES Assistant are unsophisticated and visually unappealing. The most recent version of Assistant, 2.0, offers a menu-driven interface and on-line help.

The Historical Performance Analysis feature, which consists of one app, called GRAPHS.EXE, tracks and displays the server's performance data for up to six months. GRAPHS.EXE monitors 11 server statistics.

Probably the most important of the Administrative Utilities is the File

System Reporter. This program allows you to see how many files are in the file server and gives you information about the size of those files and their directories. It also lets you look at your security systems so that you can analyze your requirements.

MICROSOFT

• Microsoft LAN Manager Toolkit for Visual Basic (\$139)

• Microsoft LAN Manager Resource Kit (\$149)

Microsoft offers several kits for monitoring utilities. The Alarm Station program, packaged with LAN Manager Toolkit for Visual Basic (\$139), lets you establish thresholds for up to 25 server statistics and set alarms for when those thresholds have been exceeded. The alarms are sent via DDE (dynamic data exchange), so they can arrive in the form of e-mail, voice mail, or other types of messages. Performance Logger, also packaged with the Visual Basic application, sends statistical data to any comma-delimited variable format.

The LAN Manager Resource Kit (\$149) provides some good tools for monitoring LAN Manager servers. The kit includes notes, hints, simple utilities, and sample code; it is targeted at corporate developers and support personnel. It comes with four network management programs: NETMON, NINFOVB, PERFGRAF, and STAT, some of which it shares with the Visual Basic package.

NETMON is an OS/2 network traffic monitor. It binds to the NDIS (Network Driver Interface Specification) card driver and collects up to 2 megabytes of the most current network packets. NINFOVB, also in the Visual Basic package, gathers server information and statistics from up to 10 different servers at user-defined intervals; this data can be imported into Excel using DDE. PERFGRAF, a

Windows-based utility developed in Visual Basic, collects and graphs OS/2 server stats.

STAT and STAT2 are character-based statistics programs; both chart data traffic in bar graphs. The STAT program quantifies data in NCB (Network Control Blocks) per second and data I/O per second and monitors mail-slot activity. The STAT2 program uses split bar graphs to show network data I/O per second for multiple servers.

NOVELL

• STAT.NLM (free utility)

• DUMPSTAT.EXE (free utility)

• NetWare Services Manager (\$4,995)

STAT.NLM and DUMPSTAT.EXE work together to monitor NetWare 3.11 file servers. Both programs are free, but you must buy the March 1992 issue of *NetWare Application Notes* magazine to get them. The issue will cost \$15; you can order it from the Novell Research Order Desk (800-453-1267, ext. 5380).

STAT.NLM is an NLM (NetWare Loadable Module) that records NetWare 3.11 server resource utilization statistics, saving them in a binary file. DUMPSTAT.EXE runs on a client PC and exports statistics for analysis by a database, spreadsheet, or other program.

If you want a more sophisticated server-monitoring package from Novell, Netware Services Manager (NSM), a Windows-based application, costs \$4,995 and comes with software and a hardware agent.

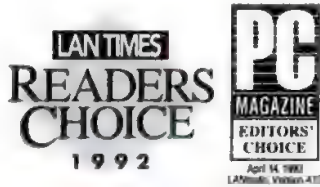
NSM monitors statistics by protocol and by traffic direction, and lets you set up thresholds and alarms on that basis. If you want in-depth network analysis, you'd best pair up NSM with Novell's The LANalyzer Network Analyzer, which costs \$12,500 for Ethernet or Token-Ring versions, or \$19,980 for both. □

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INTERVIEW #5:



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MIS Manager Nola Matthews and Tracy Schmidt, VP of Operations, First Interstate Bank of South Dakota, N.A.

In the summer of 1991, the Credit Card Division of First Interstate Bank of South Dakota needed to network 10 computers. Since they already had an open Novell® license, their first inclination was to go with Novell. But Sandy Silverberg, of **Ideasign Computers**, an Artisoft Authorized Five Star™ dealer, urged them to check out the LANtastic® networking system. Since a neighboring department was running a Novell NetWare® network (v2.15) and another department was running a LANtastic network, comparisons were easy. They chose the LANtastic system and are now up to 100 nodes – and growing. Why did they choose LANtastic?



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BCC

Monitoring Software

SUITABILITY TO TASK

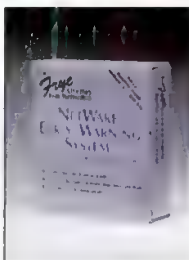
Frye Utilities for Networks: NetWare Management/ NetWare Early Warning System

	POOR	FAIR	GOOD	EXCELLENT
Reporting and statistical analysis	●	●	●	○
Hard disk monitoring	●	●	●	○
Network monitoring	●	●	●	●
User monitoring	●	●	●	○

that displays a brief message), voice mail (using your digitized voice), fax, and Lotus's cc:Mail. These options range from \$295 (for the Alpha Pager) to \$3,300 (for incoming and outgoing voice mail), and some require additional hardware.

Part of the strength of a server-monitoring package is its analysis of file-server performance. The Frye programs provide some analytical tools, and for greater functionality you can export information in dBASE and ASCII format to other applications.

There are some drawbacks. The pack-



age is missing a number of alert capabilities under NetWare 3.1x, such as notifying you of file allocation table (FAT) errors and printer off-line conditions, and the two FUN packages are pricier than the competition. The rest of the companies whose products we review cut costs in large networks by offering site licenses or multiserver pricing. Although you may be able to negotiate these options with some of FUN's resellers, they are not part of the list price schedule. And you have to purchase two packages to get FUN's full server-monitoring capabilities. NetWare Management and EWS cost \$495 each for the initial server, and \$395 each for every additional server.

NetWare Management provides some basic information about server errors in its annotated reports. This is not an on-line function, however; the information is available only after a report has been generated.

You can find more detailed explanations of specific server errors in the reference section of NetWare Management's manual. EWS, on the other hand, offers on-line help with any error when you press its help key. It explains the error and its consequences, and offers solutions to fix the problem.

Both NetWare Management and EWS are DOS-based programs that can run in the background under Windows. Under Windows 3.1, you need to have at least Version 3.26 of IPX (Internet Packet Exchange) loaded. Support for NetWare 3.1x requires an optional NetWare Loadable Module (NLM) to enable some features.

Frye offers clear, understandable documentation and free technical support by fax or toll-free phone. Its network-management products deliver ease of use and a friendly interface. If you don't mind the extra cost, you'll find the Frye programs worthwhile investments.

Brightwork Development Inc.

LAN Server Watch

BY CAROL ELLISON

Don't be fooled. Although LAN Server Watch (LSW) is a powerful monitoring package for NetWare 2.x servers, it's hardly worth the \$695-per-server price tag

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FACT FILE

Frye Utilities for Networks (FUN):

NetWare Management, Version 1.11B

NetWare Early Warning System (EWS), Version 1.1

Frye Computer Systems Inc., 19 Temple Pl.,
Boston, MA 02111; 800-234-3793,
617-451-5400; fax, 617-451-6711

List Price: NetWare Management, first server, \$495, additional servers, \$395 each. NetWare Early Warning System, first server, \$495, additional file servers, \$395 each

Requires: 640K RAM. DOS 3.0 or later, NetWare 2.x or later. For use with external programs: 500K hard disk space

In Short: The combination of NetWare Management and NetWare Early Warning System is a bit on the expensive side, but it delivers strong reporting and a wide range of notification capabilities. The programs do not track some important statistics under NetWare 3.x, however

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CIRCLE 156 ON READER SERVICE CARD

NETWORKING

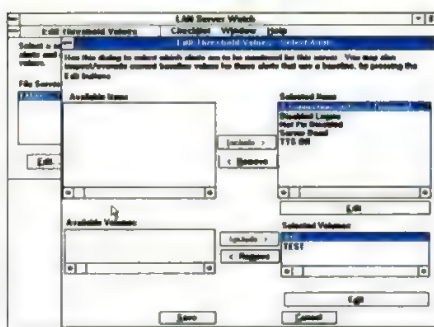
Monitoring Software

for 3.x servers.

LSW is one in a suite of network utilities from Brightwork Development. The utilities are related, but they don't store network information in a common database they can all access.

LSW can poll up to 100 file servers. Data is automatically gathered from the file server and used to establish a baseline from which to establish thresholds. LSW also accepts alerts from other packages, including Frye's NetWare Early Warning System and Cheyenne Software's Monitrix.

Unfortunately, other than alerting you to a dead server and declining disk space, LSW's monitoring capabilities are virtually useless on NetWare 3.x networks. Brightwork says that since Novell has not



Although it will monitor 35 different conditions on a NetWare 2.x installation, LAN Server Watch monitors only 5 on NetWare 3.x installations. A later version, which became available after our test period, added a sixth threshold for disk utilization.

NetWare 3.x leave LSW with only six alert situations to watch for, the fewest covered by any package reviewed here. Under NetWare 2.x, LAN Server Watch will monitor more alert conditions than its competitors (35).

You can set LSW to notify you or another user of exceeded thresholds using the NetWare Send command, Lotus's

provided an API (application programming interface) for NetWare 3.x, Brightwork has to use its own NLM to get further information concerning the server.

The program reads network information using the same APIs as Novell's FCONSOLE for NetWare 2.x. But FCONSOLE's much-reduced reporting options in

FACT FILE

LAN Server Watch, Version 1.0
 Brightwork Development Inc., 766
 Shrewsbury Ave., Jerral Center West, Tinton
 Falls, NJ 07724; 800-552-9876,
 908-530-0440; fax, 908-530-0622

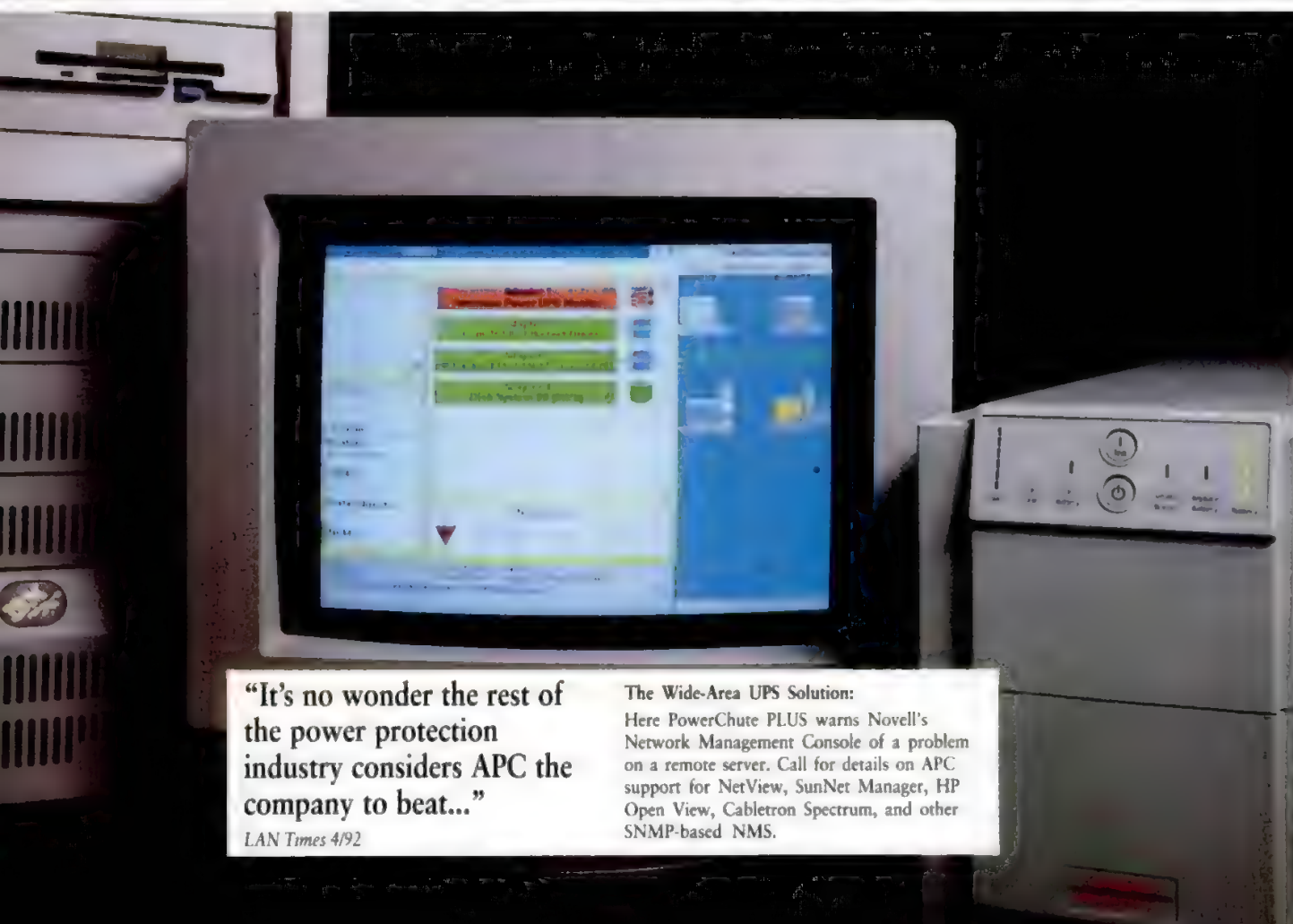
List Price: \$695 per file server; enterprise license for more than 100 users, \$1,495

Requires: 2MB RAM on the monitoring PC, 2MB RAM on the file server, DOS 3.1 or later, Microsoft Windows 3.x, NetWare 2.x or later

In Short: Brightwork Development's Windows-based LAN Server Watch is a good choice for NetWare 2.x installations, but it falters when it comes to 3.x. The most significant features are easy-to-configure thresholds, auto-baselining, and pull-down menus that interpret alerts and suggest corrective action

ON READER SERVICE CARD

cc:Mail, MHS (Message Handling Service) for e-mail, or a pager (which requires a Hayes-compatible modem). You can also run a DOS batch file to perform unattended operations.



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LAN Times 4/92

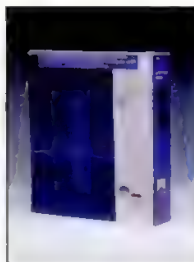
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Monitoring Software

Brightwork's LSW simplifies network troubleshooting by offering on-screen interpretations of what problems might be causing an alert. Using LSW's on-line database, the network manager can edit the interpretation screens to add information for help desk personnel, such as instructions on what to do in case of particular alerts. You can also add the names of executable files to the database menu and launch other applications.

LSW compiles alerts in a history log, which you can display graphically or in text format on-screen. It cannot send these reports directly to a printer, but it



stores the log in an ASCII format so you can print the report out from another program.

LSW's documentation reflects its NetWare 2.x orientation, with screen shots and explanations geared to the 2.x office. Only in a README file does it tell 3.x users that they must load the Brightwork NLM before running LSW. And LSW cannot run on IPX (Internet Packet Exchange) versions lower than 3.1, a fact not pointed out in the version we tested.

Brightwork offers a 30-day money-back guarantee and free support, but it has no 800 number. You can phone or fax your questions to Brightwork or post a query in its CompuServe message section. The company provides a coupon for \$15 of free CompuServe connect time.

For NetWare 2.x installations, LSW ranks high on the list of monitoring options. Brightwork is working with Novell and promises to correct LSW's NetWare 3.x deficiencies by adding 30 new alerts in the next version.

Avanti Technology Inc.

NetAlarm

NetTrack

BY CAROL ELLISON

Avanti Technology's NetAlarm and NetTrack provide excellent tools for network administration. The programs can work together or separately to monitor



NetAlarm will alert you to a variety of conditions, using NetWare's Send messaging feature, but it cannot send e-mail or dial a pager.

SUITABILITY TO TASK				
LAN Server Watch				
	POOR	FAIR	GOOD	EXCELLENT
Reporting and statistical analysis	●	●	○	○
Hard disk monitoring	N/A			
Network monitoring	N/A			
User monitoring	●	●	○	○

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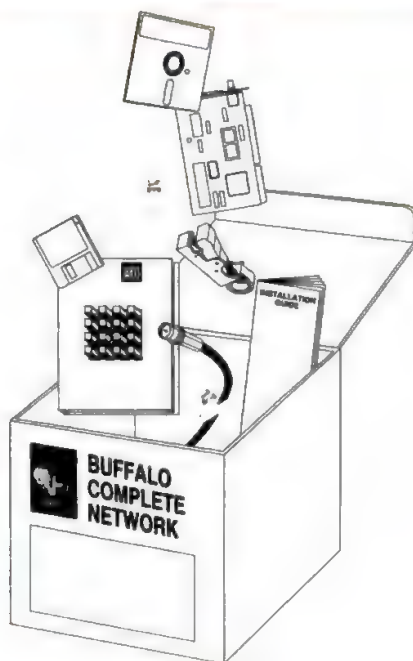
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CIRCLE 328 ON READER SERVICE CARD

■ File Wizard Does Network File Housekeeping

by Jonathan Matzkin

Unlike the other packages we review, Knowzall Systems' File Wizard, Version 2.1, focuses on network file management. File Wizard doesn't monitor system parameters, such as CPU usage. Instead, it provides tools for analyzing disk space. File Wizard's pricing starts at \$395 for one server.

You configure File Wizard to perform housekeeping functions based on its disk space analysis. The program runs on the file server and automatically handles such tedious details of file management as selecting files for deletion or archiving. Think of it as XTree on steroids. The package's only real drawbacks are the menu structure and paid support policy.

When you set up File Wizard to perform a scan, you can select a particular volume or multiple volumes for analysis. Within volumes, you can analyze a specific user's file activity and detect which users are taking up too much disk space. You can also break down the analysis by filename extension to compare the space taken by executable files with that used by data files.

File Wizard can report on a disk's slack space, both for the volume as a whole and for individual users. You can save considerable space by adjusting

the minimum block sizes that NetWare allocates for files. *Aging analysis* reports on files that have not been accessed or updated in a given interval, and *variance analysis* shows changes in the number of files, space used, and slack space over the course of multiple scans.

You can use several months of accumulated scan data to generate forecasts of storage space needs. File Wizard creates a graph that predicts the rate of growth.

You can generate and print tabular reports from this data, and export them as comma-delimited, or comma-quote-delimited ASCII.

Results of File Wizard scans are available as on-screen graphics or printed tabular reports. On-screen displays

consist mostly of charts depicting file usage; the printed reports include tabular summaries of each user's space or the entire volume by filename extension, among other criteria.

File Wizard's true power becomes evident through its so-called *action logs*. An action log combines a scan with actions that you specify for files that meet certain conditions. Unlike thresholds, action logs are not ongoing processes. They are designed to run periodically.

You could specify, for example, that

all files that haven't been touched for 180 days be archived and deleted. When you run the program, File Wizard presents you with a file action display, prompting you for confirmation of the action to be taken on files fitting your criteria.

File Wizard's main drawback is its not-quite-intuitive menu structure. You sometimes have to back up and pick a choice from a previous menu.

Knowzall is revamping the program's character-based interface for Version 2.12. It will also add report printing and directory summary reports. An NLM version, already available but not tested by us, lets you do unattended file scanning and requires NetWare 3.11.

Knowzall's support policies differ from those of the other vendors we review. It offers free technical support by phone and fax for only the first 90 days and charges \$100 for one year of support thereafter.

File management is difficult enough on a standalone PC; on a network, with a blizzard of users, filenames and types, it can be a nightmare. File Wizard simplifies this odious task while helping you predict your future file storage needs. □

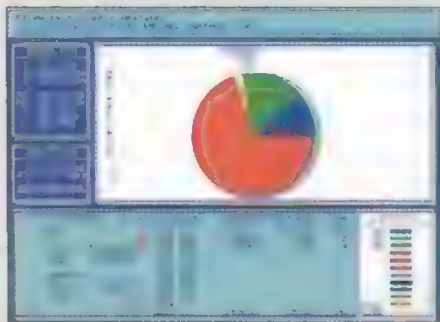
File Wizard, Version 2.1

Knowzall Systems Inc., 375 E. Elliot Rd., #10, Chandler, AZ 85225-1130; 602-545-0006; fax, 602-545-0008.

List Price: Single-server version, \$395; 3-server version, \$595; 8-server version, \$995. NLM version, add \$100.

Requires: NetWare network.

Circle 530 on reader service card



File Wizard displays graphic views of storage space usage on the network. Here the files of an individual user are broken down by extension in the pie chart.

and log the condition of up to eight NetWare 2.x and 3.x file servers. NetAlarm and NetTrack cost \$495 and \$325 per site license, respectively. Bundled together, they sell for \$625 per site license.

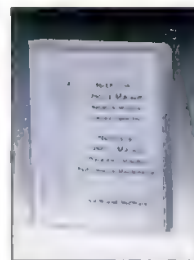
NetAlarm provides monitoring features and notifies you when a threshold is exceeded. NetTrack tracks similar information, but with an eye toward planning; thus, it displays average and peak server

usage based on user-defined polling cycles. And as with Brightwork's LAN Server Watch, Avanti makes using NetTrack easy by automatically compiling a baseline of network data.

Both packages run on any station on the network and gather server information using an NLM, or a VAP (value-added process) under NetWare 2.2.

Many of the statistics NetTrack collects are found in NetWare 2.x's FCONSOLE and MONITOR.

In addition, Avanti's NLM reads data not tracked by FCONSOLE and MONITOR from various locations and utilities within the operating system. The NLM does not track a number of statistics offered by Fresh Technology's NetVision, how-



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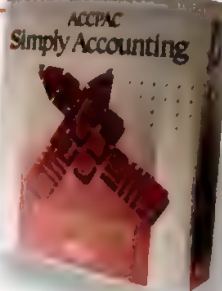
CP—copy-protected; NCP—not copy-protected.

The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

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We carry only the latest versions of products. Version numbers are current at press time. Products listed here in red are Microsoft Windows Applications.

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AddStor ... NCP	
4090	■ SuperStor 2.0 79.
Adobe Systems ... NCP	
7547	■ Adobe Type Manager 2.0 for Windows 65.
6591	□ Adobe Illustrator 4.0 for Windows 389.
5988	□ Adobe Illustrator Competitive Upgrade 189.
7940	□ Adobe Type Set Value Pack 39. (Entire Adobe Type Library, from 1 to 275 is available. Call for more information.)
Aldus ... NCP	
8000	□ Persuasion 2.1 for Windows 329.
1332	□ PageMaker 4.2 for Windows 499.
6223	■ Gallery Effects for Windows 139.
7540	□ IntelliDraw 199.
Alpha Software ... NCP	
5104	■ Alpha FOUR 2.0 329.
Application Techniques ... NCP	
8337	■ WinDings 1.0 for Windows 49.
1214	■ Pizazz Plus 3.0 79.
Approach Software ... NCP	
6598	■ Approach 1.0 for Windows 265.
Area Software ... NCP	
6030	■ FontMonger 1.0 for Windows 95.
Artisoft ... NCP	
2455	Lantastic AE-2 EtherNet Starter Kit 4.1 (incl. software, 2 EtherNet cards, cable) 479.
2452	AE-2 EtherNet Adapter Card 199.



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7336	■ Label Pro 1.6 for Dot Matrix 49.
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Berkeley Systems ... NCP	
9885	■ After Dark 2.0 for Windows 29.
Bitstream ... NCP	
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2089	■ MakeUp 1.0 for Windows 3.0/3.1 95.
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9695	■ Borland C++ 3.0 325.
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9635	■ Object Vision 2.0 99.
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8114	■ Backup 7.1 (DOS and Windows) 84.
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5987	■ AllClear 1.0 179.
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7546	■ DOS Membership Kit 1.3 25.
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3814	dBFast (3 1/2" only) 339.
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9627	■ Netroom 2.1 52.
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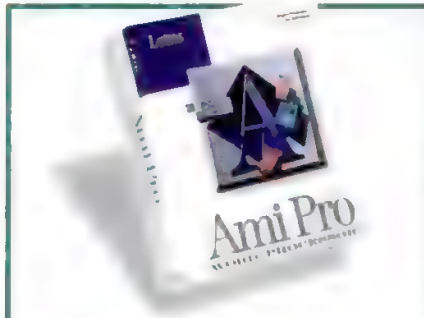


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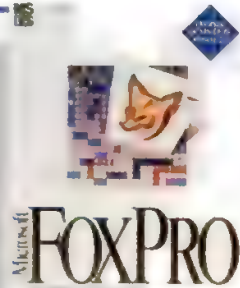
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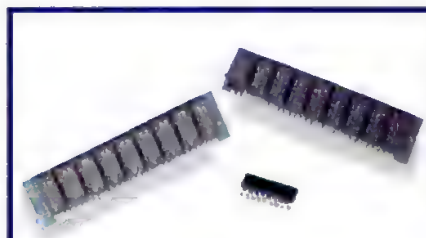
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 2358 LQ-570 (80 col., 252 cps) 289.
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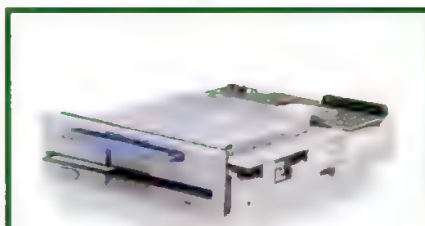
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SUITABILITY TO TASK

NetAlarm/ NetTrack

	POOR	FAIR	GOOD	EXCELLENT
Reporting and statistical analysis	●	●	●	○
Hard disk monitoring	●	●	○	○
Network monitoring	●	●	●	○
User monitoring	●	●	○	○

ever, like cache thrashing, cache utilization, FAT errors, and Bindery objects. And during our tests, a bug in the NLM did cause NetAlarm to miss a hard disk failure. Avanti says it has fixed this problem in Version 3.10, which shipped after our test period.

The NLM offers an impressive array of statistics for NetWare 3.x networks. Still, some of the features available with Avanti's VAP under 2.x were not available for 3.x. Under NetWare 2.x, the current version of NetAlarm monitors 31 server statistics, while NetTrack monitors 22. Both products monitor 22 statistics under 3.11. Since our testing, Avanti has added digital paging and MHS messaging to Version 3.10.

NetTrack and NetAlarm log data in both ASCII and semicolon-delimited formats. The data can then be read by and printed from a word processor or database report writer.

Avanti targets both products toward small workgroups, although technically there is little preventing NetAlarm and

NetTrack from operating in large workgroups. NetAlarm can operate in as little as 64K RAM as a foreground operation on a node as basic as an 8088 with a monochrome monitor—a point that administrators of small LANs will appreciate. It can also run as a TSR, using about 12K on a monitoring station. As with Frye's products, you can load it into high memory.

Avanti's documentation for both products is unusually good. It includes pertinent NetWare 2.x and 3.x information, and recommendations on where to set thresholds. Finally, technical support is free to registered users, and available via Avanti's 800 and fax numbers and its CompuServe mailbox.

Avanti's easy-to-read reporting screens and its attention to detail in its documentation make NetAlarm and NetTrack excellent products for small offices that lack full-time certified network administrators. The added notification options in Version 3.10 should remedy some limitations in the version we tested.

Fresh Technology Co.

NetVision

BY PADRAIC R. BOYLE

If you're looking for a strong NetWare 3.1x monitoring package, Fresh Technology Co. just may have the solution for you. NetVision, priced at \$695, can monitor 24 statistics across eight NetWare 2.x and 3.1x servers simultaneously. What's more, NetVision provides tools to locate network problems quickly. But limited notification options and its lack of some important server configuration data-finding tools may discourage some potential buyers.

NetVision consists of two portions. The file server runs three NLMs or VAPs, depending on whether it is running a 3.1x or 2.x environment. On a DOS client station, a network monitor displays the information gathered from the server.

Like the other packages in this review, NetVision tracks critical server statistics through user-definable thresholds. When a threshold is exceeded, NetVision logs the event in an error file and notifies you via the Novell Send command.

You can either view NetVision's



NetVision's histogram for our server "FALBO" shows block usage, CPU utilization, and server usage. In this screen, the scale is based on block usage.

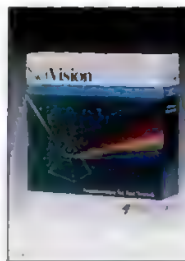
server statistics in real time, store them for later analysis as a line graph or .PCX file, or you can print them out in the form of a pie chart. NetVision is also the only package that exports statistical data in Lotus 1-2-3 format.

Analyzing information in a spreadsheet can be especially important when you are trying to isolate network problems. NetVision lets you compare the distribution of network traffic across multiple servers. But this feature is practical only when you are comparing servers on platforms consisting of similar hardware and software.

NetVision is also the only package reviewed to locate network errors by testing IPX performance between stations. This test can help diagnose relatively simple problems, such as a bad network adapter or cable.

There are drawbacks to NetVision. For one, you cannot view configuration data about server components like the memory, driver software, NetWare OS version, volumes, name spaces, serial numbers, hard disk size, and partition table. What's more, the presentation charts are not extremely useful. Although they display statistics from up to eight servers simultaneously, the graphs need to be clearer and more consistent in scale.

Finally, Fresh Technology needs to improve NetVision's notification capabilities. The Novell Send command is effective only if you are logged on to the server when a threshold is exceeded or an error occurs. To reach the administrator in other circumstances, NetVision needs to support e-mail or a beeper, or at least be



FACT FILE

NetAlarm, Version 3.0

NetTrack, Version 2.0

Avanti Technology Inc., 13740 Research Blvd., #R-1, Austin, TX 78750; 800-282-6844, 512-335-1168; fax, 512-335-7838

List Price: NetAlarm, \$495 per site, NetTrack, \$325 per site. Both packages, \$625 per site.

Requires: 12K to 64K RAM on client PC, DOS 3.0 or higher, NetWare 2.1 or higher.

In Short: NetAlarm's limited notification options make it a less-than-adequate alerting tool. Strong documentation and good statistical reporting, however, make NetAlarm and NetTrack excellent choices for network planning and administration in workgroups of 30 or less.

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NETWORKING

Monitoring Software

SUITABILITY TO TASK

NetVision

	POOR	FAIR	GOOD	EXCELLENT
Reporting and statistical analysis	●	●	●	○
Hard disk monitoring	●	○	○	○
Network monitoring	●	○	○	○
User monitoring	●	●	●	○

able to trigger DOS batch files.

The documentation on NetVision is decent and made the installation process much easier than anticipated. The index at the back, however, is consistently wrong by a page or two. In case you need help, there is a toll-free technical support phone number and fax support.

In order to reach the administrator during emergencies, NetVision should support e-mail, a beeper, or at least be able to trigger DOS batch files.

NetVision tracks more 3.1x parameters than any of the other packages we reviewed, and its strong data export capabilities give it an edge over the competition. Still, Fresh Technology needs to add some important statistics and enhance the product's range of notification features. □

FACT FILE

NetVision, Version 2.0T

Fresh Technology Co., 1478 North Tech Blvd., #101, Gilbert, AZ 85234; 800-793-7374, 602-497-4200; fax, (602) 497-4242

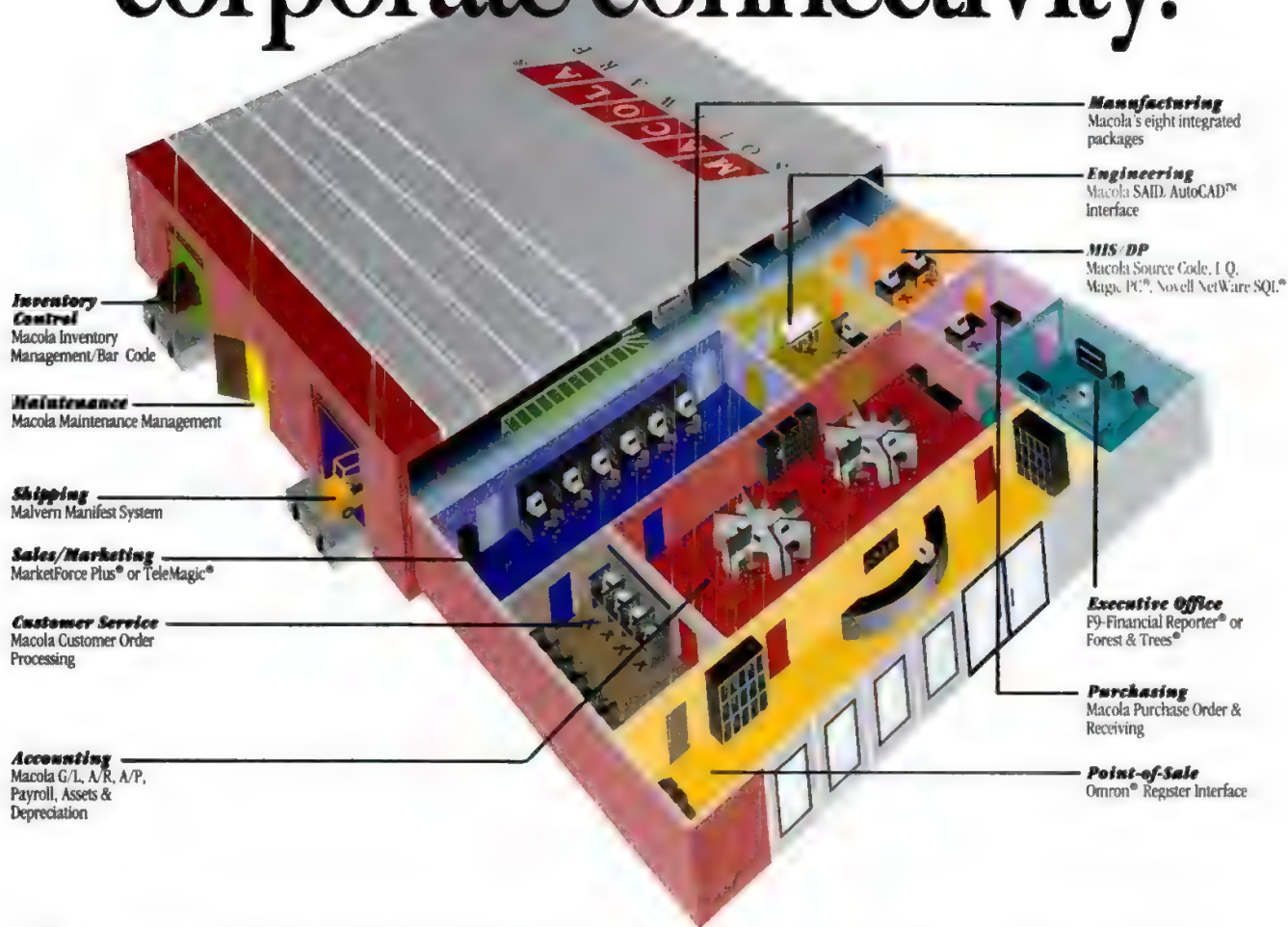
List Price: Up to eight file servers, \$695

Requires: DOS 3.0 or higher

In Short: NetVision can collect statistical data for up to eight NetWare 2.x and 3.1x servers simultaneously. Network manager notification, threshold management, and graphical presentation are included. Notification options and file server management are limited, however, and the graphical data the package displays can sometimes be misleading.

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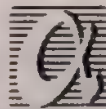
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InfoWorld, May 11, 1989 DBMS, December, 1990,
PC World, March 1991 PC Computing, June 1992
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**LOW-COST
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The lure of a compact, affordable multipurpose tool never seems to go away. So it is no surprise that integrated software packages, which provide the basic tools needed to do most of the kinds of work that we address with computers, have become a firmly established if not best-selling category of software. What *may* come as a surprise, however, is that, driven by mass-market hardware sales and a mass movement to small business, competition in the low-cost or entry-level integrated software

An inexpensive suite of productivity applications with a consistent interface is pure seduction. The choices are getting better, but is the sum of the parts greater than the whole?

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ILLUSTRATION BY DAVID FLAHERTY

by Ted Stevenson

Low-Cost Integrated Software

market is heating up fast—considerably faster than in the high-end integrated software category. Vendors are positioning themselves to feed an exploding demand.

The evolution of integrated software—software that includes, at minimum, word processing, database, and spreadsheet capabilities—has its roots in the early 1980s. Integrated software was touted as a PC user's panacea for two reasons.

First, each of the many applications running under DOS looked and behaved differently; each had unique menu and command structures. Integrated applications that shared a similar user interface could theoretically slash the learning curve.

Second, and a bit more ethereal, was the notion that data could be shared among applications. The reality, however, was that moving and combining data

among disparate PC application packages was a daunting endeavor—easy in theory; difficult or nearly impossible in practice. Early integrated packages were not especially good at data-sharing.

MOVING TOWARD THE WORKS

Integration happened in many different ways. Back in the CP/M days, for example, Micropro (developers of WordStar) offered spreadsheet and database products with formats that were easily edited in the word processor: Data could be documents or “non-documents.” Lotus Development Corp., noticing that a large number of its customers were trying to use its spreadsheet-database product, Lotus 1-2-3, to perform

extensive text-creation and data-management tasks, developed a set of program overlays that could be loaded in memory

to help the spreadsheet handle these jobs more effectively. Lotus called the resulting package Symphony, and scads of users still embrace it as their computational Swiss Army knife. Ashton-Tate Corp., of dBASE fame, vied for a share of this new all-in-one

Today, practically every major vendor in the integrated software marketplace has a product with the word works somewhere in the title.

market with the powerful Framework.

While integrated software for the PC aimed at the power user, a new breed of low-cost integrated software was born on the Apple platform. Software Publishing Corp.'s PFS:File migrated to the IBM/DOS platform and grew into a series of data-compatible applications that gave users modular integration. The products in the PFS series later coalesced into a single simple-to-use package, PFS:First Choice, which continues on under the aegis of its new owner, Spinnaker Software Corp.

Also born in the Apple world was the first self-contained integrated package designed to provide a compact entry-level suite of applications for computer novices: AppleWorks for the Apple II.

Works became the watchword. It took root in the DOS world with Microsoft Corp.'s creation of Microsoft Works in the fall of 1987. Today, practically every major vendor in the integrated software marketplace has a product with the word *works* somewhere in the title. And while heavyweights such as Symphony 2.X (soon to be 3.0), Framework IV, and Enable OA continue to sell in their specialized markets, it's the entry-level “Works Pack” that's really making noise today.

THE SUM OF THE PARTS

A package that does not include at least word processing, spreadsheet, and database management modules—and does not allow easy transfer of data between them—cannot legitimately call itself integrated. Most integrated packages also offer other capabilities, typically one or more of the following: business charting,

Suitability to Task:

Low-Cost Integrated Software

These Suitability to Task ratings compare each integrated software package against the standards of popular standalone products. For instance, you might need the database functionality of Q&A but very little word processing capability, or you might want the spreadsheet prowess of Lotus 1-2-3 plus a powerful word processor.

The ratings also measure the degree of integration between modules in a given package, as well as a package's suitability to life on a laptop. All told, these ratings can help you find the right combination of tools to fill your work needs.

Each package's capabilities are rated in six areas. The scores in the first four categories—word processing, database, spreadsheet, and communications—reflect how well the integrated package's individual applications stand up to the best-selling standalone applications.

To earn a rating of *excellent* in the **word processing** category, a package must be comparable to a low-cost product such as PFS:Professional Write PLUS or JustWrite. To receive a top **database** score, a package should match the capabilities of Q&A or PFS:Professional

SUITABILITY TO TASK					
Product Name		POOR	FAIR	GOOD	EXCELLENT
Word processing		●	○	○	○
Database		●	●	○	○
Spreadsheet		●	●	●	○
Communications		●	●	●	○
Integration		●	●	●	●
Portability		N/A			

N/A—Not applicable. The product does not perform this task.

File. A package's **spreadsheet** strength is measured against Lotus 1-2-3 and Microsoft Excel. To receive a high rating in the **communications** category, a module should have the performance quality of Crosstalk or Procomm.

Integration rates a package's ability to perform tasks that require cooperation among several modules, mostly in the form of data transfer. In addition to database and spreadsheet features, this score reflects mail-merge, direct data transfer, dynamic file linking, and the implementation of word processing features such as spell-checking, type enhancement, and search-and-replace across applications.

Portability rates a package's viability as a portable-computing tool. The score includes such factors as the ability to customize the installation (and the uninstall routine), the product's disk space requirements, and the ease with which data can be shared with desktop computers.

vector drawing, graphics importing and editing, and telecommunications.

To be included in our review, the packages had to list for \$200 or less, have been introduced or significantly upgraded since our last roundup, and offer word processing, spreadsheet, and database modules plus, at a minimum, either graphics or telecommunications. We also review Microsoft Works and Framework XE. Neither meets our upgrade criterion, but having received Editors' Choices in our August 1991 roundup they are the targets at which competitors have been aiming their development efforts.

A couple of packages did not make our testing deadline. Enable Software replaced its technically outstanding entry-level package, Enable/BP, with an interface-enhanced Enable Works (welcome to the Works Pack!), but the new product was not shipped in time for this review. Similarly, Microsoft could not ship version 3.0 of Works in time for our testing. Both products are scheduled to be on dealers' shelves by the time you read this.

HOME SWEET HOME

While broad functionality is the essence of an integrated package, it is not always perfectly balanced across applications. Most integrated packages have a "home" application—one module that dominates the product's personality.

In the case of Lotus Symphony, it is the spreadsheet; after all, Symphony is virtually built on top of Lotus 1-2-3. But while the spreadsheet in LotusWorks is strong, as you would naturally expect in a Lotus product, the database is perhaps the strongest module. (Lotus acquired this package—which was formerly called AlphaWorks—from Alpha Software, a strong database vendor, which explains this surprising twist. Lotus's strong spreadsheet for the low-cost market can be found in the newly released Lotus 1-2-3 for Home.)

You would, of course, expect a product bearing the WordPerfect name to offer strong word processing, and WordPerfect Works for DOS lives up to that expectation. Word processing is also the strength of the two Spinnaker products, Eight-In-One for Windows and PFS:WindowWorks. This makes sense, since word pro-



EDITORS' CHOICE

• Microsoft Works for Windows 2.0

Integrated software packages, like clothes, are many things to many people. But four essential dimensions take the overall measure of a product in this category: completeness, integration, ease of learning and ease of use, and cost.

Our Editors' Choice, Microsoft Works for Windows 2.0, stands out clearly from the rest of the packages we review here in at least two respects. Its integration is second to none, and the combination of a refined graphical interface, a first-rate tutorial, and Microsoft's proprietary WorksWizard technology claim for it both the ease of use and ease of learning honors.

In one sense, Works for Windows is less complete than some of its competitors—including the DOS version of Works—since the package itself includes neither a communications module nor file-management facilities. Microsoft's reasoning in omitting these elements seems to make sense, however: They are available in Windows itself; why duplicate?

The only measure by which Works for Windows clearly shows to disadvantage is cost. With a \$199 list price, it is the most expensive of the packages we reviewed. Yet at street prices, only \$25 to \$35 separates this package from the rest of the crowd (except for

Spinnaker's Eight-In-One for Windows, which lists for just under \$60!). This kind of price spread probably won't be a purchase deterrent for most prospective buyers.

The Windows factor, of course, is a crucial choice point for many of today's buyers. While Windows adds value to integrated software, it exacts its own price—both the cost of Windows itself and the cost of the hardware overhead. Those who eschew Windows (for whatever reason) are fortunate in the range of good choices open to them.

Microsoft Works 2.0 (last year's co-Editors' Choice) is perhaps the best balanced of the DOS-based lot. LotusWorks 3.0 offers more database power than its peers; newcomer WordPerfect Works for DOS offers a powerful suite of applications, except in the database area. Those for whom ease of learning and interface friendliness are not paramount issues can avail themselves of the extraordinary integrative powers of Framework XE.

processing modules are used far more by the computing novices at whom these packages are aimed. Framework XE, and the two Microsoft products, Microsoft Works and Microsoft Works for Windows, do a good job of balancing the functionality of the three primary applications.

LEARNING EASE

A standard complaint about integrated software in the past has been that it is difficult to learn. Inconsistent interfaces and awkward, unintuitive commands are common hindrances. In the old days, many users were willing to climb a steep learning curve for the sake of integrated software's special benefits. Today's users,

however, demand instant productivity, and vendors are becoming more savvy about ease-of-learning, ease-of-use, and interface issues.

Among the current offerings, Framework XE probably requires the most patience and dedication from those who would master its abilities. This is due largely to the unusual—and powerful—overall design of the program. At the other end of the spectrum are the Microsoft Works products, which embody some of the most advanced tutorial techniques available in any PC-based software (including animation and sound in a special release of the program, Microsoft Works for Windows, Multimedia Edition).

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Microsoft's WorksWizards, automated routines for organizing and executing tasks, add a further dimension of usability.

Lotus, too, has done a good job of integrating tutorial functions into its entry. You can access the LotusWorks tutorial anytime, get the guidance you need, and return directly to your task.

In terms of user interface, mouse support and pull-down menus are now universal. The graphical packages—and even the character-based Microsoft Works and LotusWorks—offer mouse-style navigation with scrolling arrows, close boxes, and some icons. Microsoft Works for Windows, Eight-In-One, and PFS:WindowWorks have adopted the toolbar approach, which is fashionable among high-end standalone Windows applications.

All of the packages we reviewed handle integrating tasks such as mail-merge or inserting a graph, table, or spreadsheet into a document with relative ease. Even the most rudimentary Windows-based packages make integrating data even easier by relying, at minimum, on the Windows Clipboard and easy task switching for data transfer. To date, among the integrated packages, only Microsoft Works for Windows takes advantage of one of Windows' more sophisticated data-linking capabilities: DDE (Dynamic Data Exchange). None of the packages reviewed here supports (OLE) Object Linking and Embedding, where you can actually access features of another application without leaving your current one. MDI (multiple document interface), implemented in the three Windows packages, allows you to keep multiple documents open, viewable, and editable on-screen simultaneously.

THE INTEGRATED SACRIFICE

So what do you give up when you pass on standalone applications and yield to the seductive charms of affordability, all-in-one convenience, and easy data sharing? Integration and price issues aside, whether you work in the DOS or the Windows environment, choosing a low-cost integrated package means you will be giving up power.

CAPACITY

By going the integrated route, you are likely to sacrifice, well, let's call it big-

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Low-Cost Integrated Software

ness. For example, few low-cost integrated packages can match the heavyweight spreadsheets in the sheer size of the grid, and none matches them in the number of mathematical functions provided. With databases, the bigness comparison is even more one-sided. Stand-alones are likely to offer bigger databases (more records), bigger records with more (and more different kinds of) fields, more functions, and far more extensive and flexible indexing and reporting. Among the entry-level integrated packages reviewed here, only LotusWorks offers anything approaching the relational capabilities that are fundamental to standalone database products.

FEATURES

If you opt for an integrated package, you can also expect to sacrifice an overall richness of features. Today's most sophisticated word processors, for example, offer spelling-checkers, thesauri, and grammar checkers, collapsible outlining, paragraph numbering, automatic table-of-contents and index compilation, versatile font handling, multilevel sorting, stylesheets, glossaries, embedded math functions, automated table creation, graphics editing, and extensive drawing tools. An integrated package may have some of these, but it is not going to have all of them.

Standalone packages are also more equipped to run in a networked environment. Only WordPerfect Works and both the DOS and Windows versions of Microsoft Works have a network version, making them the only reasonable choices for the small-business environment.

Cutting-edge spreadsheets offer multidimensionality, group file handling, multilevel sorting, and charting capabilities that would shame the full-blown charting packages of only a couple of years ago. They also have sophisticated data manipulation features like cross-tabulation and what-if analysis, and a host of conveniences like prepackaged styles and auto filling of both headings and data.

AUTOMATION

Finally, standalone packages are certain to win any automation/programmability contest. The degree of programmability that we have always expected in a high-end database has long since become part of sophisticated spreadsheets and is now taking hold in top-of-the-line word processing software as well. While every integrated package we examined in this review has the ability to automate tasks through some sort of macro or batch language, they don't begin to measure up to the power and sophistication of the languages woven into the heavyweights.

A GAIN IN PORTABILITY

On the other hand, if you value portability, especially portability of a suite of applications, over and above the sophistication of one application, then an integrated solution may be your ticket. Despite the fact that they are an umbrella for multiple applications, integrated packages are surprisingly lean. The packages we reviewed ranged from occupying 2MB to 7.5MB of disk space when fully installed (see the features table for details). Furthermore, several of the installation routines, like the one in LotusWorks and Microsoft Works for Windows, are customizable to allow you to bring the components you need on the road and leave the rest at home. Others like Framework XE and Microsoft Works 2.0 win big because they can fit on a single 3.5-inch floppy.

IN SUM

The good news is that today's crop of entry-level integrated software packages offer more functionality at a lower cost than ever before. For users who require a solid word processor with mail-merge capability plus access to basic spreadsheet and database functions, any of the packages reviewed here will serve well—with prices starting at a startling \$59.95 list (Spinnaker's Eight-In-One).

Those requiring a higher level of functionality (primarily greater spreadsheet and database prowess) should investigate

The good news is that today's crop of entry-level integrated software packages offer more functionality at a lower cost than ever before.

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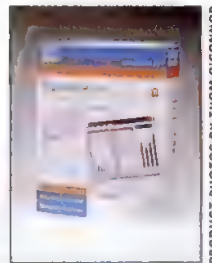
the relative merits of the Works Pack: Framework XE, LotusWorks, Microsoft Works, PFS:WindowWorks, and WordPerfect Works (all \$149 except for the last, which is \$159). Users who delight in the latest conveniences—and those who want to get up and running with a minimum of effort—owe it to themselves to look at Microsoft Works for Windows (\$199). Those with particular needs for capable databases should probably look at Framework XE, LotusWorks, and the Spinnaker Software Corp.

Spinnaker Software Corp.

Eight-In-One for Windows, Version 1.0

BY JONATHAN MATZKIN

While Spinnaker Software Corp.'s Eight-In-One for Windows, Version 1.0, may not compete on a feature-for-feature basis with higher-end integrated software packages, its extremely low price, \$59.95, makes it worth considering for value-minded users. Not only is it priced competitively with many low-end standalone word processors, but Eight-In-One also offers a full complement of basic business tools. Besides a spreadsheet and a flat-file database, it supplies a simple graphics module, a telecommunications program, a utility for printing mailing labels, and an address book. But one of the package's biggest drawbacks is that data integration is only handled via the Windows Clipboard and not through any dynamic data links.



PRODUCT PHOTOS BY THOM D'CONNOR

STRONG WORDS

As with most Windows applications today, Eight-In-One's word processor mixes graphics and text adroitly. Graphics objects can be easily dragged around or sized within a document. Text is automatically flowed above and below—but not around—graphics objects. The word processor is the only module that can open multiple documents (up to four).

Sophisticated editing capabilities include creating and storing multiple stylesheets, outlining, creating a table of

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Eight-In-One for Windows				
	POOR	FAIR	GOOD	EXCELLENT
Word processing	●	●	●	○
Database	●	●	○	○
Spreadsheet	●	●	○	○
Communications	●	●	○	○
Integration	●	●	○	○
Portability	●	○	○	○

contents, and running headers and footers.

Strong as it is, Eight-In-One's word processor is not perfect. It does not offer an index generating function or provisions for automating footnotes or endnotes.

Some of these deficiencies are relatively easy to swallow, but the lack of data links to the spreadsheet and charting modules is irksome. Graphs and spreadsheet ranges can be placed in Eight-In-One word processing documents via the clipboard, but since they aren't linked to the modules where they originated, they aren't automatically updated to reflect changes in data.

SPREADSHEET AVERAGE

Eight-In-One's spreadsheet module offers basic functionality, such as the ability to enter formulas and perform math functions in a cell, but it lacks some critical features. For instance, during testing we discovered that Eight-In-One can't sort a worksheet. The absence of so basic a capability severely limits the value of a

spreadsheet to many users. Column widths can be adjusted, but only by entering values through a dialog box, instead of a more intuitive graphical manipulation option.

Eight-In-One's charting module offers a selection of nine chart types. Its capabilities are modest, though sufficient for producing simple business graphs. To graph a range, you copy it to the clipboard and then paste the data into the chart module. It's a simple, smooth operation, but again the lack of live links to the spreadsheet data means that you have to reimport your data every time it changes. Links from the chart editor to the spreadsheet are nonexistent, and text charts are not supported.

UNEVEN DATABASE

The flat-file database module has some real strengths and some real weaknesses. Creating a data-entry form is a simple, quick process. You paint fields and field labels by pointing to their approximate location in the template and then filling in the details in a dialog box. Modifying a database form is as easy as dragging fields around with the mouse.

The shortcomings are a bit maddening, however. The most serious limitation is that databases can only be sorted in ascending order. Further, in testing this module, we found that it cannot mail-merge tagged records within a database. We were forced to either enter a range of record numbers in a dialog box that appears during the mail-merge process or export all the records we wanted to merge into a separate database. A record-by-record form view is the only built-in view. You can create a tabular view in the report generator, but that is a lot of work to get to something that should have been included already.

The product's communications module has the necessary tools to log on to online services and make uncomplicated modem-to-modem file transfers. Aside from the usual terminal emulations and a small assortment of file-transfer protocols, the module also offers a dialing list. Unfortunately, the communication module's scripting capability will be of little use without better documentation. Overall, it is not much of an improvement over Microsoft Windows' built-in Terminal accessory.

If you compare the features table entries for this package with those for Spinnaker's PFS:WindowWorks, you will make an interesting discovery: They are almost identical. Closer inspection reveals that Eight-In-One is basically a stripped down version of the \$149 PFS:WindowWorks. Eight-In-One, however, lacks PFS:WindowWorks' dynamic data links between modules, and its documentation seems to have been hastily adapted from PFS:WindowWorks' docs with minimal changes. In fact, the manual occasionally refers to capabilities that Eight-In-One does not have.

A significant difference in price and reduced hard disk space requirements are probably the two best reasons to choose Eight-In-One over the more capable PFS:WindowWorks or a similar package from another vendor. These considerations aside, \$59.95 is an attractive price for a good word processor; on this basis alone Eight-In-One is worth a look.

Borland International Inc.

Framework XE, Version 1.0

BY HENRY FERSKO-WEISS

This may be the last time you read about Framework XE in these pages. Last year's co-Editors' Choice has been slated for extinction. The program's new owner, Borland International, which acquired the package in the Ashton-Tate Corp. buyout, does not plan any upgrades. But Borland does plan to continue support of the DOS-based product indefinitely, albeit in a narrow technical support schedule (8:00 AM to 12:00 PM Pacific time). This should be some solace for devotees of what is probably the most truly integrated and definitely the most compact package in this review.

Actually, the components of the \$149 Framework XE are more than integrated—they are unified. Each application—the word processor, spreadsheet, database, and communications modules—is always active, so in a sense you are in all these facilities at once. Thus, you can spell-check not only a text file, but a spreadsheet or database as well. You can



FACT FILE

Eight-In-One for Windows, Version 1.0

Spinnaker Software Corp., 201 Broadway,
Cambridge, MA 02139; 617-494-1200;
fax, 617-494-1219

List Price: \$59.95.

Requires: 1MB RAM (1.5MB recommended), DOS 3.1 or later, Microsoft Windows 3.0 or later.

In Short: If price is your most pressing consideration, take a look at this stripped down version of Spinnaker Software Corp.'s more expensive PFS:WindowWorks. A solid word processor outshines the other components, and data exchange among modules is limited.



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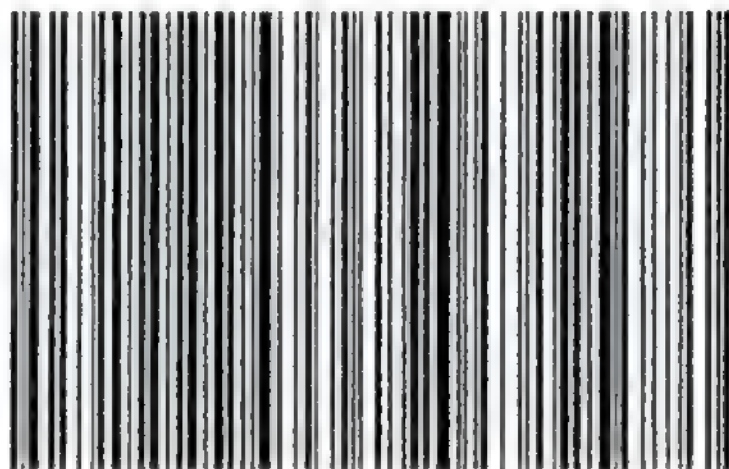
Gbs5lipBack-0013



Inverted Back

1. Follow instructions on the other side

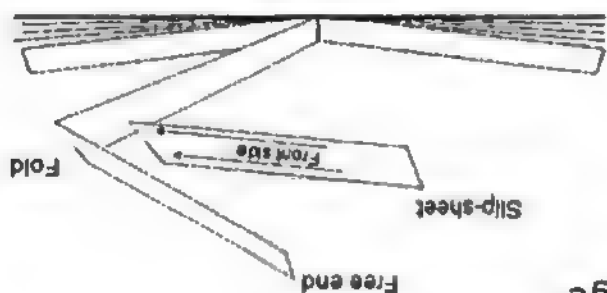
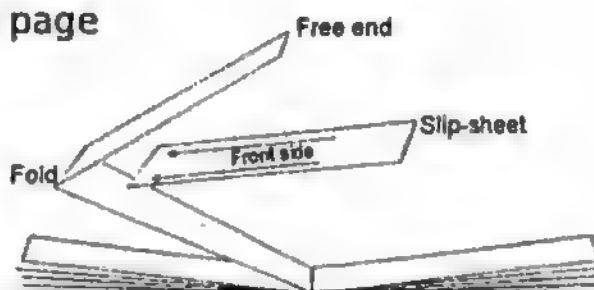
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Inverted Foldout slip-sheet

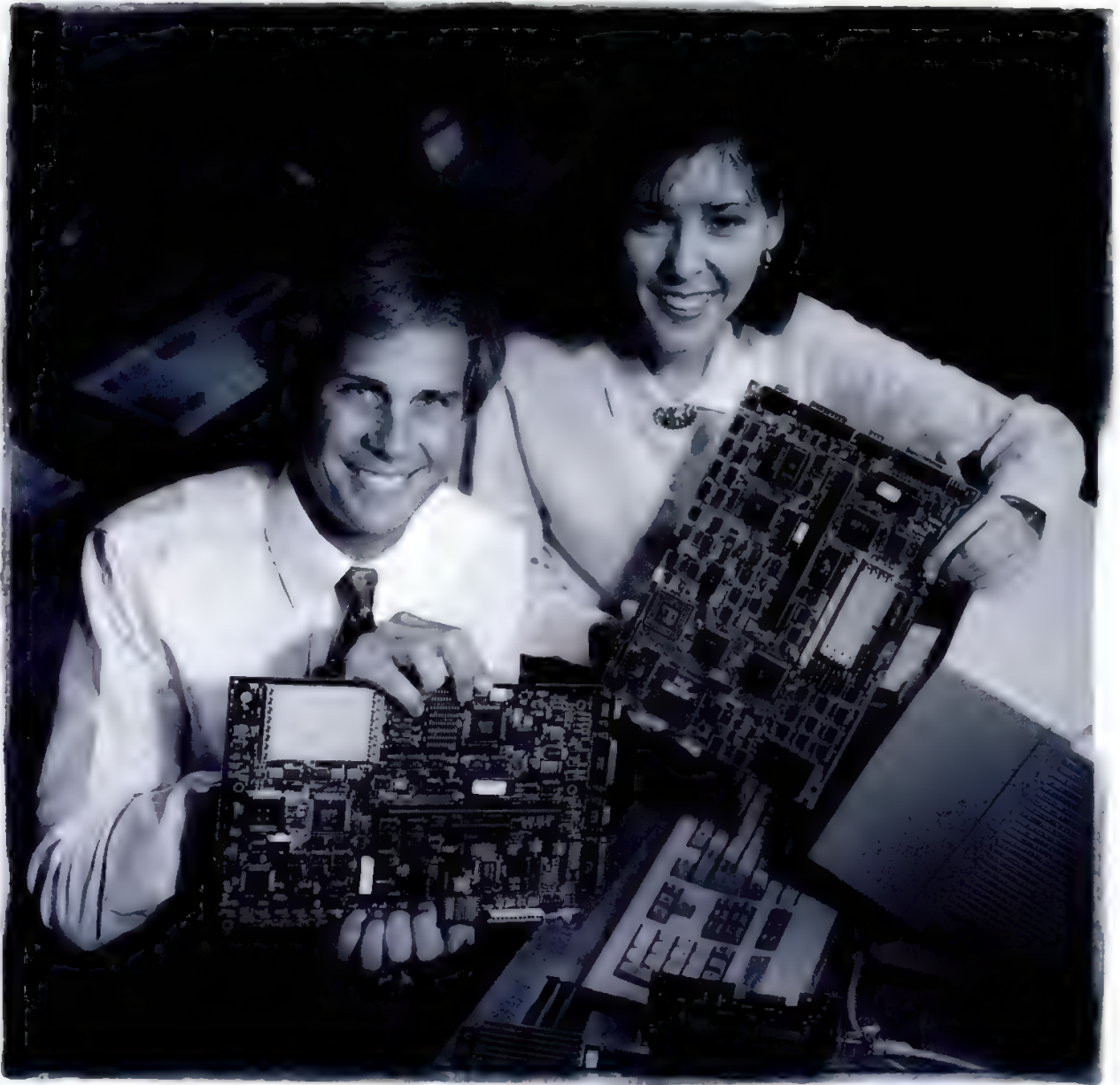
1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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also apply styles and print commands to text documents and spreadsheets at the same time. Framework XE lets you create compound outlines and documents easily, so you can organize and manage information creatively. Above all, you don't have to exit one module and enter another to do cross-application work.

In addition to the looming specter of extinction, Framework XE suffers from at least one potential limitation: The package keeps all of your information in RAM. When files are large or when you have many files open, you can run out of memory. Framework XE allows you to configure the setup to use expanded memory, however. Depending on the amount of available RAM, this can help your operations go more smoothly. Framework XE also lets you select page to disk as an option. Unfortunately, this slows down the package significantly.

FRAME IT YOUR WAY

Framework XE uses a unique approach to file and document structure. Everything that you create in the program happens within *frames*—windows that you can size and move around on-screen.

Each frame belongs to one application/function (such as word processing and database), but files can be composed of a free mixture of different types of frames. You can have any number of frames open at once, forming your "desktop." Individual frames can also be zoomed to fill the whole screen so you can work with more information at once.

Data frames can be placed inside of *containing frames*, which act, in a sense, like outline levels. Large spreadsheet or word processing documents can even be broken up across data frames inside the container frame in order to create more manageable chunks.

The modules in Framework XE are more than integrated, they're unified. Each area is always active.

FRAMEWORDS

Framework XE's word processing capabilities are fairly standard. You can rearrange or align text easily. Search-and-replace operations can be case-sensitive, global, or conditional, and can use wildcards. Tabs lack special alignment (right, center, and decimal). The spell-checker supports personal dictionaries. Framework XE lacks some of the more up-to-date word processing features, however, such as a thesaurus, automatic hyphenation, bookmarks, hidden comment fields, footnotes, and endnotes. Framework XE displays text attributes on-screen, so you can see italics, boldface, underline, and strike through, but the program offers only one system font.

STANDOUT SPREADSHEET

Framework XE's strong spreadsheet can be quite large, at least theoretically: 32,000 columns by 32,000 rows. The maximum number of active cells that can contain data, however, is 32,000, which works out to about 180 by 180.

Data in the spreadsheet can be formatted in all the standard ways. Formulas are entered with the @ symbol. The module offers access to 182 functions, which is by far the most of any product reviewed. Other features that make the spreadsheet facilities shine are the abilities to protect cells and to lock rows and columns in place so they will not scroll out of view.

SUITABILITY TO TASK

Framework XE

	POOR	FAIR	GOOD	EXCELLENT
Word processing	☒	☒	☐	☐
Database	☒	☒	☐	☐
Spreadsheet	☒	☒	☒	☐
Communications	☒	☒	☒	☐
Integration	☒	☒	☐	☐
Portability	☒	☒	☐	☐

One of the best things about the spreadsheet in Framework XE is that it allows you to link one spreadsheet to another or to a word processing or database frame dynamically. In this way, you can pull in or compute values from a spreadsheet or update values in another frame every time the spreadsheet changes. Unfortunately, since this is a spreadsheet-specific feature, you cannot dynamically link databases or word processing documents without involving a spreadsheet.

Graphs can be created simply by highlighting a range. You can select from eight types, including bar, stacked bar, pie, line, x,y, and high-low-close.

FAVORING TEXT DATABASES

The database function lets you format data-entry fields as character, numeric, date, time, logical, and formula. Each field can contain up to 64K of data, which facilitates keeping a large text-based database.

There are several ways to view a database: as a tabular list, as a form, or in one-field-per-line "dBASE view." In the forms view, fields are frames within a containing frame. The field frames can be dragged around within the container to reorder the design. Once you have the form set up, the frame borders can be turned off to make it look more like a traditional form.

POWERFUL COMMUNICATOR

Framework XE also comes with a telecommunications module that lets you preconfigure remote service setups and put them on a menu. There is an MHS-based electronic mail facility as well. Framework XE has a macro capability and lets you perform file management operations without going to DOS or lets you go to DOS to run other programs.

While Framework XE may be at an

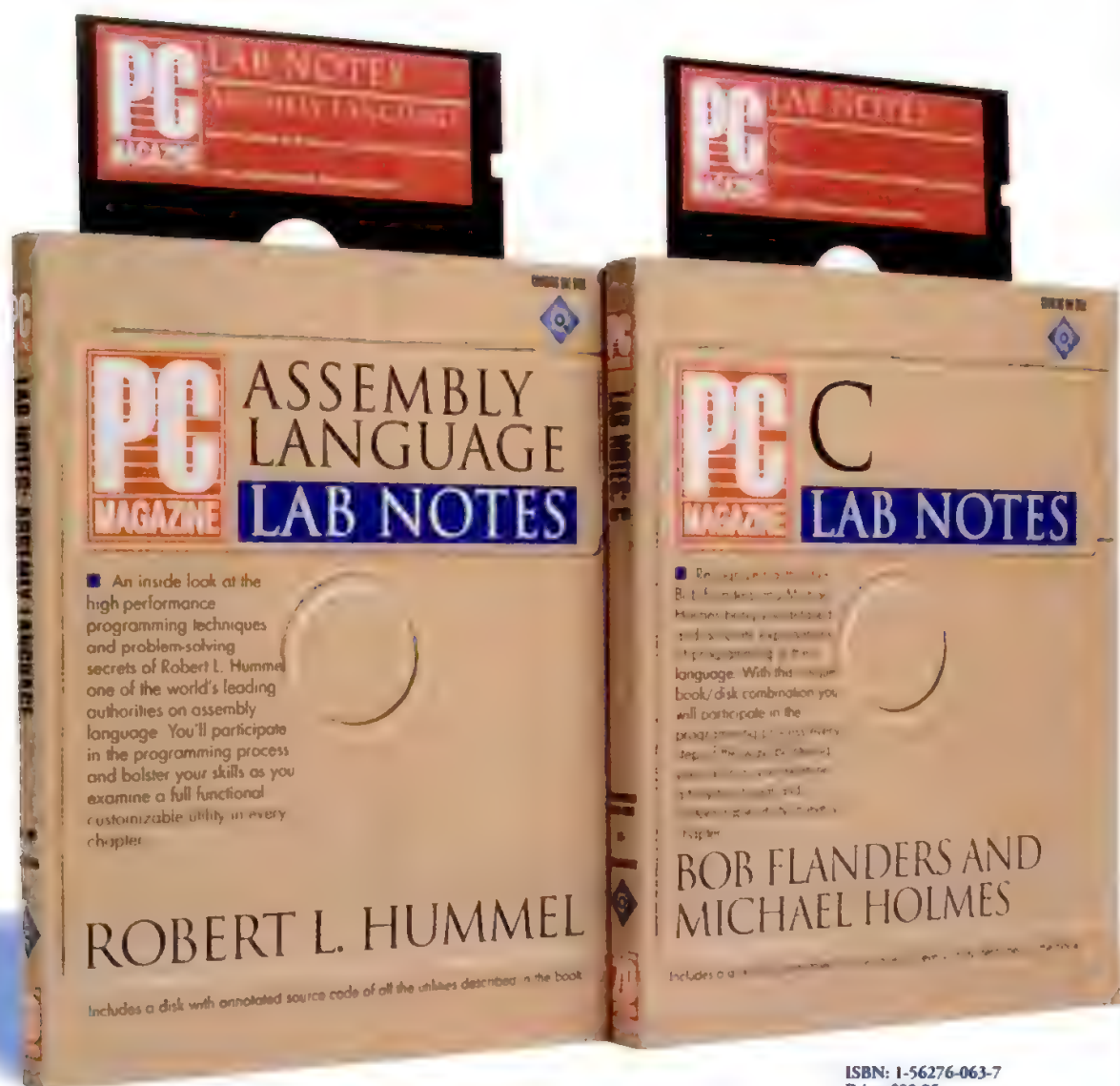

FACT FILE

Framework XE, Version 1.0
 Borland International Inc., 1800 Green Hills Rd., Scotts Valley, CA 95067; 408-438-8400

List Price: \$149
Requires: 640K RAM, DOS 2.0 or later (to use electronic mail, DOS 3.0 or later).
In Short: Framework XE's word processor, spreadsheet, graphics, database, communications, and electronic mail modules are all available at the same time, making them more unified than integrated. You have to become accustomed to the frames orientation of the program before you can unleash all its power; learning Framework XE takes time. Also, prospective purchasers should be aware that Framework will not be upgraded—ever. They should be sure this is the program they want—just as it is.


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■ GEOWORKS PRO: *More than Just a Poor Man's Windows*

by Robert Kendall

A core of staunch supporters have long lauded the GeoWorks graphical operating environment for being what Windows should be. It is fast, will run on a minimal hardware platform, allows preemptive multithreaded multitasking, and is often easier to use.

Since GeoWorks has yet to release a software development kit, few applications exist for the environment. But GeoWorks Pro includes enough mini-applications and utilities to make it a good alternative for some people to the more comprehensive packages we reviewed in this story.

GeoWorks Pro costs \$199.99 and includes—in addition to the operating environment—a word processor, a drawing module, a communications module, and various accessories. The package also contains Borland International's Quattro Pro, Special Edition, for DOS. (GeoWorks Pro is actually a combination of an improved version of GeoWorks Ensemble and Quattro Pro SE and is considered a replacement for the former. Upgrades for Ensemble users cost \$49.99.) The lack of a native database made GeoWorks Pro ineligible for our reviews.

The remarkable GeoWorks Pro windowing interface emulates, somewhat, the look and feel of Windows, and appears to be an even closer relative of the original Macintosh interface. It also adds some nifty extras, such as *sticky* menus that you can leave conveniently floating on-screen after making a command selection.

File management is often easier than under Windows. GeoWorks Pro allows long filenames and depicts each data file with an icon representing the file type. You can move or delete files by dragging, and double clicking on a file launches the application that created it. When you exit GeoWorks

Pro and return, you will find all open applications and files just as you left them.

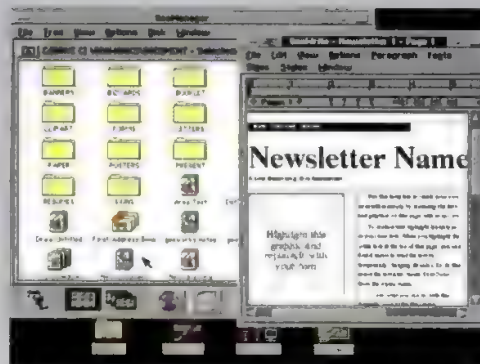
While GeoWorks Pro provides data linking between the address book and the appointment calendar, this advanced feature is lacking elsewhere. Multimedia support is absent. Also, working with DOS applications is more difficult in GeoWorks Pro than in Windows because GeoWorks Pro only lets you run one DOS app at a time.

The GeoWorks Pro word processor is heavily oriented toward desktop publishing. It excels at fancy layouts, allowing such enhancements as graphics (pasted from the draw module), snaking columns, text boxes with drop shadows, colored text, and variable character spacing. This eye appeal, however, comes at the expense of some basic text processing functions. There is no thesaurus, search and replace, or mail-merge, and scrolling across page breaks is awkward.

The graphics editor provides elementary functions for creating graphics primitives and working with colors and fill patterns. You can flip, rotate, and group objects, and import .PCX and TIFF files. Both the graphics editor and word processor share the same set of nine scalable fonts (from the German type supplier URW).

The communications module is limited: It lacks an automatic redial feature and supports only Xmodem for binary-file transfers. Nevertheless, it does let you create log-on scripts, and a separate phone book accessory will autodial the numbers you store in it.

GeoWorks Pro provides a utility for viewing Quattro Pro spreadsheets and charts. You can also use it to copy spreadsheet ranges or charts to the clipboard for pasting into the word processing or graphics modules.



GeoWorks Pro's Windows-like interface features a file manager that shows each subdirectory and data file as an icon.

If you want to edit a spreadsheet or chart, you can launch Quattro Pro from the spreadsheet viewer. You will find yourself back in the text-mode world of DOS, but the spreadsheet's power largely makes up for this. Notable are the multiple document windows, the print preview, and the features for boxing, shading, or changing fonts in cell ranges.

The modules included with GeoWorks Pro leave too many serious gaps in functionality to compete head-to-head with the integrated packages reviewed here. After GeoWorks releases its forthcoming software development kit, these gaps may be filled by third-party vendors. (Products are expected in the third and fourth quarters of this year.) For now, GeoWorks Pro will appeal to those who feel that having one of the best graphical interfaces around is more important than a full range of features.

GeoWorks Pro

GeoWorks, 2150 Shattuck Ave.,
Berkeley, CA 94704; 510-644-0883;
fax, 510-644-0928.

List Price: \$199.99.

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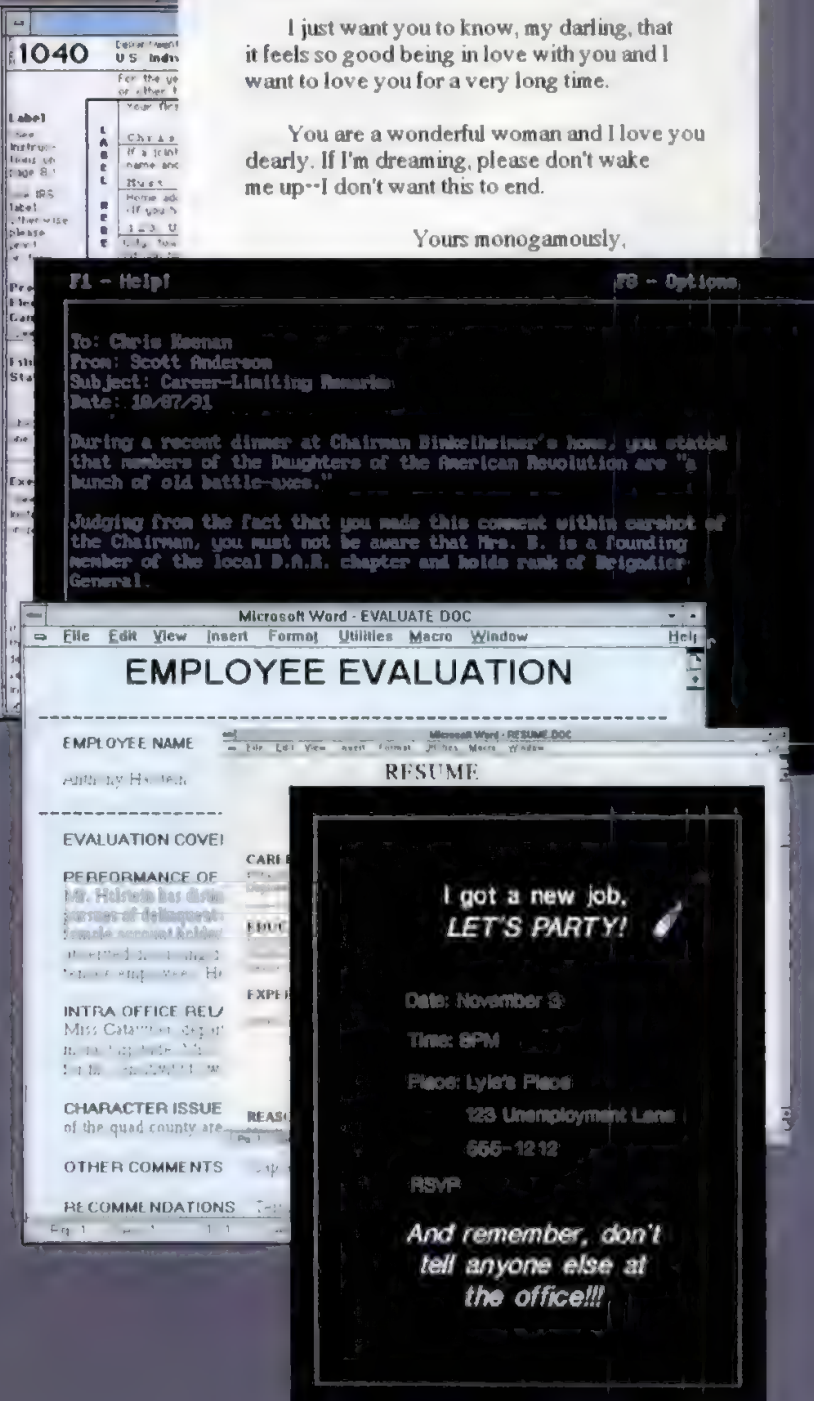
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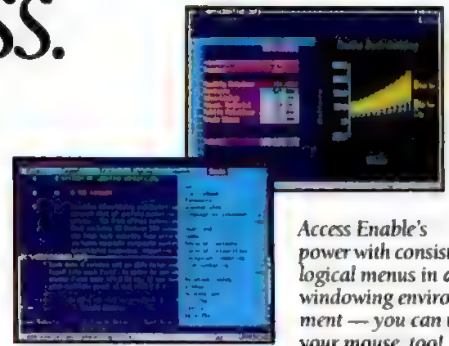
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evolutionary dead end, it still offers some of the most powerful integration features available. For those willing to learn its idiosyncratic interface, it remains a serious and powerful business computing tool.

Lotus Development Corp.

LotusWorks, Version 3.0

BY ROBERT KENDALL

Lotus Development Corp.'s new overhaul of LotusWorks, Version 3.0, combines a spreadsheet, a word processor, a database, and communications under a single, rather novel interface. This \$149 package has many attractions, as well as a few significant liabilities. Since Lotus originally acquired the product from Alpha Software Corp., the creators of Alpha Four, it is no surprise that the product has both a strong database and a strong spreadsheet component.



LotusWorks runs in text mode but tries hard to emulate a graphical environment. The interface comprises pull-down menus, dialog boxes, scroll bars, and full mouse support. The start-up screen lets you launch a module by double clicking on its icon, and you can run different modules or display multiple data files in overlapping windows. Moving or resizing windows is awkward, though, since it requires a series of keystrokes.

The program also works well without a mouse—a plus for laptop users. The comprehensive context-sensitive hypertext help can prove invaluable for guiding you through the package's sometimes thorny interface. There is also a very slick on-line tutorial that you can start from anywhere within the program to provide context-sensitive lessons.

1-2-3, IS THAT YOU?

Meeting LotusWorks' spreadsheet is a bit like being introduced to a distant cousin. There is a clear family resemblance (in this case to the Lotus 1-2-3 clan), yet much is distinctly different. In fact, while endeavoring to achieve interface consistency across all the LotusWorks modules, Lotus has groomed the spreadsheet mod-

ule (née AlphaWorks) to be as Lotus 1-2-3-like as possible. To this end, Lotus has implemented the familiar slash-key method of initiating command sequences in this product (along with LotusWorks' native F10 method), making many sequences identical to those in Lotus 1-2-3. The module features robust formula handling and a good set of functions, though you can't select them from a pick list. Manipulating data or ranges is always straightforward, and you can import and export several formats, including .WK*. You have no control of fonts within a range, however.

A charting facility provides a simple way to generate all the basic graph types from selected ranges. Unfortunately, you cannot control fonts or reposition chart elements. The lack of a graphics editor for enhancing charts further conspires toward rather drab depictions of your data.

ROBUST BASE

LotusWorks' database is the most full-featured of the packages we reviewed. Its native format is .DBF (dBASE), and it

SUITABILITY TO TASK				
LotusWorks				
	POOR	FAIR	GOOD	EXCELLENT
Word processing	●	●	○	○
Database	●	●	●	○
Spreadsheet	●	●	●	○
Communications	●	○	○	○
Integration	●	●	○	○
Portability	●	○	○	○

imports ASCII and .DIF files. It supports calculated fields, data validation, and some elementary relational functions. You can search or index on multiple fields and save different indexes or queries for each database. You can create attractive data-entry forms and save several forms and table views per database. The report generator lacks a few basic capabilities, however; in particular, it does not allow report titles.

The trade-off for LotusWorks' database power is a steep learning curve, at least for an entry-level product. The interface is sometimes confusing and even

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simple tasks can require users to construct formulas, which are not always documented accurately. A generous collection of sample database files, however, may help offset these difficulties for some users.

CLUTTERED WORDS

The word processor is functional but far from elegant. It comes with a set of four attractive soft fonts and handles them well. Simple formatting is unproblematic. But we were bothered by the obtrusive formatting codes that cluttered our test

document, and we were unable to hide them. The word processor has no pretensions toward DTP, providing no support for embedded graphics (besides charts), columns, or stylesheets.

We were able to embed graphs and spreadsheet ranges in our test document and retain hot links to the data. We found that the program added garbage characters to the graph embedded in our test document, but the vendor promises a bug fix by the time you read this.

Mail-merge is easy in LotusWorks. We picked field names from a list when con-

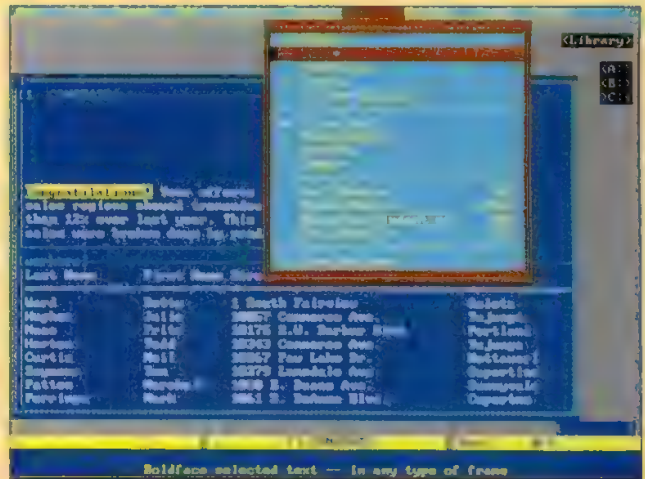
structing our letter, and the package provides mailing label support. The word processor's graphical print preview is crude by today's standards; the text is rarely legible and there is no way to zoom in for a better look.

COMMUNICATIONS: GOOD AND NOT SO GOOD

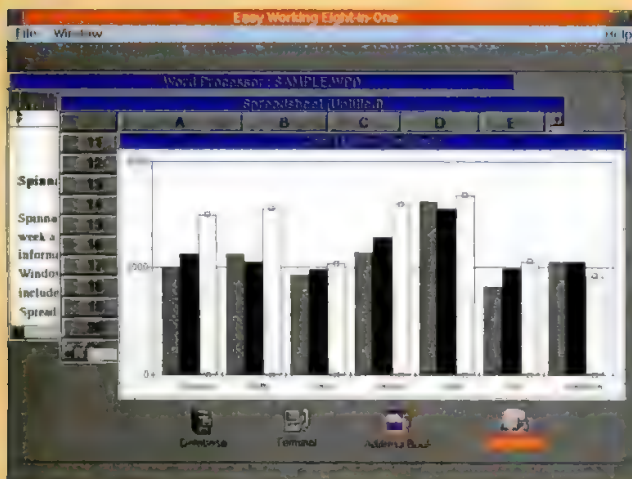
LotusWorks' communications module supports a slim selection of file-transfer protocols but lacks its own phone book. You can autodial directly from a predefined address file in the database, however.

Putting It All Together

Seven integrated packages, seven different ways of sharing data and menu structures. On the DOS front, the newcomer is WordPerfect Works; LotusWorks has been overhauled, and the old standbys, Framework and Microsoft Works, remain unchanged. Windows brings new versions of two products from Spinnaker; both had DOS versions. But the beauty of the bunch is Microsoft Works for Windows.



Framework XE uses frames instead of documents as its organizing principle. In the containing frame shown here, you see a word processing frame above a database frame. Notice the text-format options available from the pull-down menu.



Eight-in-One for Windows has all of the basic tools for constructing compound documents, but it lacks the data integration of state-of-the-art software.

 A screenshot of the LotusWorks software interface. It shows a database table with columns for 'LASTNAME', 'FIRSTNAME', and 'STR'. The table contains several rows of data, including names like 'Varga', 'Ward', 'Schmidt', etc. To the right of the table is a word processing frame with a menu bar and a text area. The text area contains a letter template with fields for 'FIRSTNAME', 'LASTNAME', 'STREET', 'CITY', 'STATE', and 'ZIP'. The letter template also includes a salutation 'Dear' and a closing 'Sincerely'.

LASTNAME	FIRSTNAME	STR
Varga	Steven	1 C
Ward	Betty	1 S
Schmidt	Carlo	18
Patterson	James	18
Hughes	Julie	18
Naas	Fritz	181
Bannig	Marlena	181
Hurlon	Todd	183
Curtis	Neil	183
Seymour	Ton	183
Bower	Ione	184
Patton	Marshall	185
Messerschmidt	Al	186
Forrings	Mark	186
Grant	Nitzi	186
Miller	Harold	187
Steger	Curt	187

LotusWorks lets you run different applications in overlapping windows. With a strong database and a weak word processor, it's not as easy to use as you would hope.

Low-Cost Integrated Software

Creating log-on scripts is remarkably easy. Just turn on the module's learn mode and enter a phone number. The program will connect you to the BBS and record not only your keystrokes but the prompts received from the remote modem as well. When you save the log-on file, LotusWorks also saves the phone number and communications parameters you used.

TRANSFERABILITY

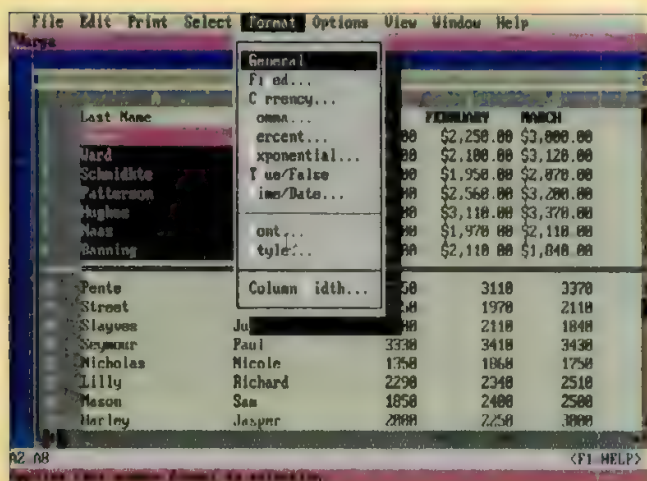
In testing LotusWorks, we were able to transfer large chunks of data between the

spreadsheet and word processor modules by means of the package's internal clipboard. You can even transmit the contents of the clipboard over your modem! LotusWorks would not, however, let us export mail-merged letters as ASCII files for modem transmission (something that was part of one of our communications tests).

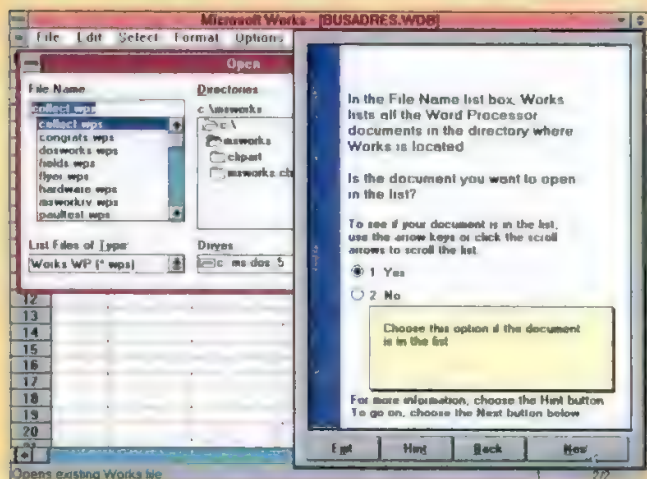
As a whole, LotusWorks fails to provide all the extras that make an integrated software environment truly self-contained. You cannot add other applications or utilities to the product's

menu, for example, nor can you perform file management tasks. The latter will probably mean frequent shelling out to DOS (something LotusWorks does allow you to do), but we found this especially irksome, since we often found the mouse driver disabled when we returned to LotusWorks. This integrated software package has a couple of other problems, including limited printer support and sluggish performance on anything less than a fast 386 system.

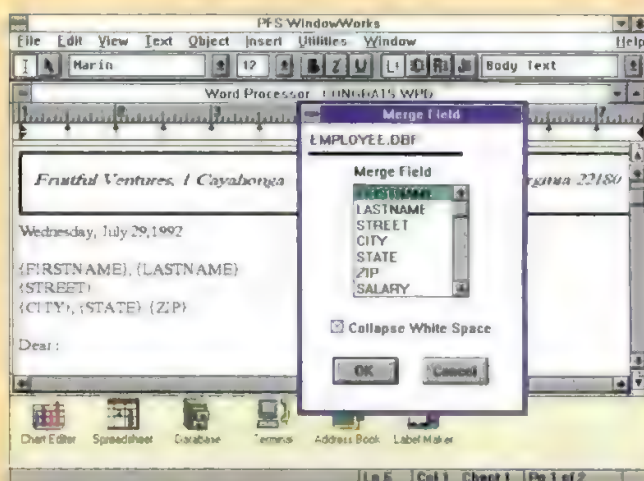
LotusWorks has a lot going for it, including robust database and spreadsheet



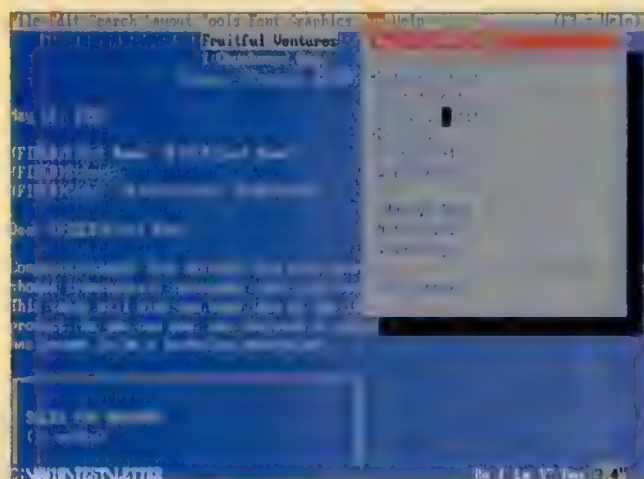
In Microsoft Works' graphics mode, you can view text styles, such as the bold month titles. You also can pick printer fonts, although they won't show on-screen. The work area here is split in two horizontally so you can see two different areas of the same spreadsheet.



Microsoft Works for Windows includes interactive routines called WorksWizards for creating an address-book database, mailing labels, and form letters (pictured here). After you make the appropriate selections, the WorksWizard finishes the setup and completes the operation automatically.



PFS:WindowWorks makes placing merge fields simple. Once you choose an address book or a database, you position the text cursor at the proper point in the document, pop up the merge-field window, point, and click.



You can switch from one WordPerfect Works for DOS application to any other via pull-down menus. As you'd expect, WordPerfect Works is stronger on word processing.

FACT FILE

LotusWorks, Version 3.0

Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500

List Price \$149

Requires: 640K RAM, DOS 3.0 or later, Microsoft Windows 3.0 or later 286-based PC or better recommended. EGA or VGA, mouse optional

In Short: LotusWorks combines powerful spreadsheet and database modules with word processing, charting, and communications. But even with extensive on-line help and tutorials, the program can be rather difficult to use

 ON READER SERVICE CARD

features and hot linking. Yet if you think *entry-level* should mean easy-to-use, you will be disappointed by LotusWorks, Version 3.0, despite the exemplary on-line help and tutorial provided by Lotus Development Corp. If eye-grabbing printed output is a primary concern, you will also find better options elsewhere.

Microsoft Corp.

Microsoft Works, Version 2.0

BY HENRY FERSKO-WEISS

Even though Microsoft Works, Version 2.0, is a character-based program running under DOS, it closely resembles its Windows counterpart. As such, it is exceptionally graphical and easy to use. The \$149 former Editors' Choice offers good feature sets in its word processing, spreadsheet, and database modules. The relatively limited spreadsheet and database sizes may prove inadequate for some users, however, and the communications module offers only bare bones facilities. On the other hand, a scheduled upgrade (see "In the Works" in this review) is expected, among other things, to rectify the size barriers in both the spreadsheet and database.

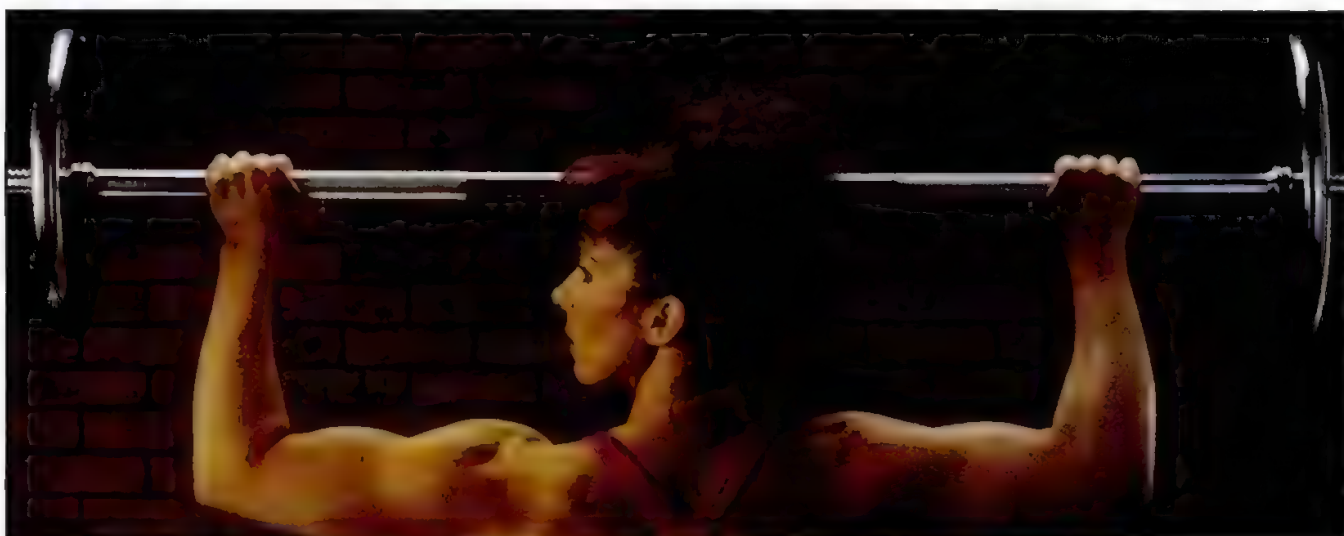
Windows users should appreciate Microsoft Corp.'s effort to capture the spirit of that GUI environment in Microsoft Works. Besides having a very Windows-

like interface, which includes a drop-down menu bar and mouse controls, Microsoft Works lets you open up to eight windows at once—including any combination of applications—and easily tile and resize them.

Users can work in either text or graphics screen display mode. In text mode, character attributes such as boldface and underline are indicated by colors, and the mouse pointer is a one-character box. In graphics mode, type styles such as boldface and italics appear on-screen somewhat the way they will look when printed. While Microsoft Works gives you access to whatever fonts your printer supports, there is no true WYSIWYG display available.

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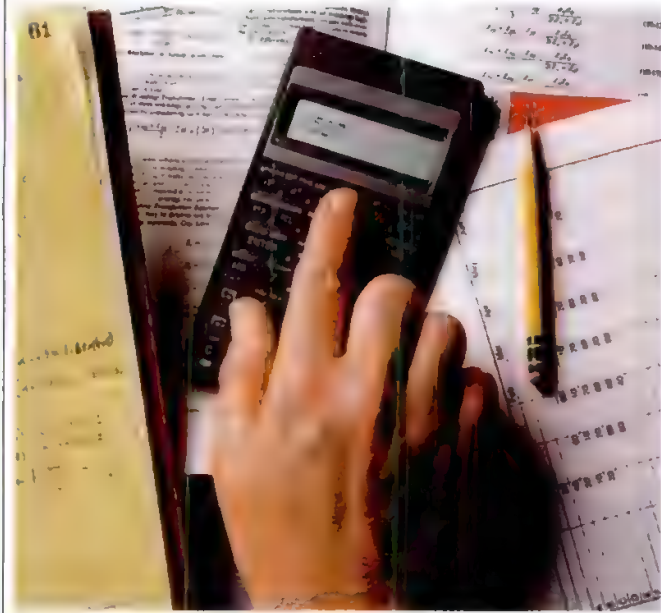
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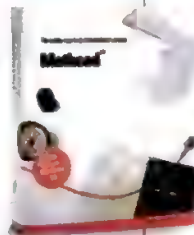
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List price		\$59.95	\$149.00	\$149.00	\$149.00	\$199.00	\$149.00	\$159.00
General Features								
Total disk space used by fully installed package		2.6MB	2MB	6.8MB	2.5MB	7.5MB	3.5MB	4MB
Can run from single 1.44MB floppy disk		□	■	□	■	□	□	□
Can act as shell for other applications		□	■	□	■	□	□	■
Network version available		□	□	□	■	■	□	■
Automation through macros		□	■	■	■	□	□	■
Windowing capabilities:								
Maximum number of active windows		10	32,000	9	8	8	10	Unlimited
Maximum number of active applications		7	32,000	4	8	8	7	Unlimited
File handling:								
Copies files		□	■	□	■	□	□	■
Moves files		□	■	□	□	□	□	■
Formats disks		□	□	□	■	□	□	□
Renames files		□	■	□	■	□	□	■
Performs automatic backups		□	□	□	■	□	□	■
Other operations		None	Creates and removes directories; deletes files	None	Creates, deletes, and removes directories; sets date and time	None	None	Creates directories; deletes, merges, and previews files
File access security		□	□	□	□	□	□	■
Device support:								
Math coprocessors		□	■	■	■	■	□	■
Color printers		□	■	■	■	■	□	■
HP LaserJets and compatibles		■	■	■	■	■	■	■
PostScript printers		■	■	■	■	■	■	■
Mice		■	■	■	■	■	■	■
Desktop accessories:								
Alarm		□	■	□	■	□	□	□
Calculator		□	■	□	■	□	□	□
Calendar		□	■	□	□	□	□	□
Appointment book		□	■	□	■	□	□	□
Phone directory		■	■	□	■	■	■	■
Other		Label maker	None	None	None	Notecards	None	Notecards
On-line tutorial		□	■	■	■	■	□	□
Word Processor								
Maximum document size		Limited by RAM	Limited by RAM	Limited by RAM	Limited by RAM	Limited by disk space	Limited by RAM	Limited by disk space
Holds full document in memory		■	■	■	■	□	■	■
Maximum number of open documents		4	32,000	9	8	8	4	Unlimited
Maximum amount of EMS memory		N/A	16MB	65K	4MB	N/A	N/A	32MB
Text formatting:								
Variable page length within document		□	■	□	■	■	□	■
Paragraphs can be kept together on a single page		□	■	□	■	■	□	□
Maximum number of text columns		1	255	1	1	1	8	1

N/A—Not applicable: The product does not have this feature.

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Processor	68000	68000	RISC/8220	RISC/8220
Fonts	14 HP Fonts	17 or 35 Scalable	35 Scalable	35 Scalable
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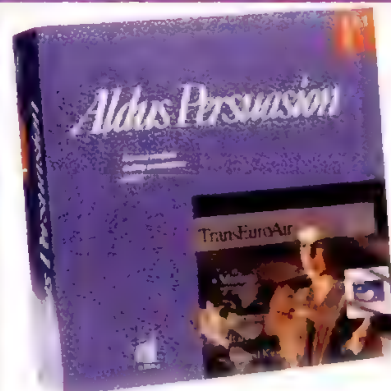
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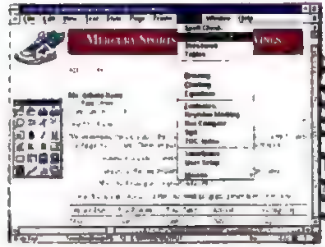
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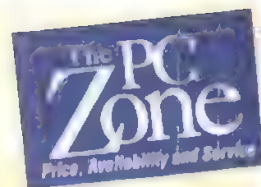
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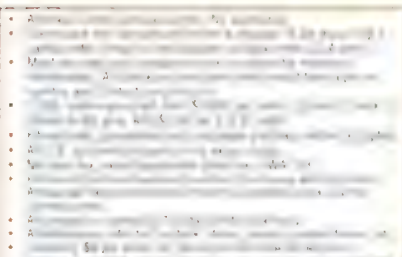


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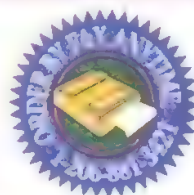
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Where Power Is Shared: The LAN ZONE

One of the newest developments in information systems for power-using businesses is the installation of a Local Area Network, or LAN. Functioning much like a server, a LAN lets connected PCs access shared information. But a LAN has many advantages. It allows PCs to function as peers, able to use each others full functions from any unit on the connected system. Any PC accessing the LAN also has full use of all

connected peripherals, as if it were connected to them directly. A Local Area Network can also be accessed from a remote PC not on the network; even one connected to another LAN in another city (via modem). The configurations of a LAN are almost limitless. And the benefits of sharing information in a peer-to-peer fashion will have you wondering how you ever did business without one.



Network 3.11

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Now the PC Zone is your authorized dealer for Novell products. Novell is the industry leader in complete connectivity solutions. And now you can get the power of Novell products at prices you won't find anywhere else. Whether you are just starting a network or expanding an existing one, the PC Zone is your source for networking products from Novell.

Ethernet 16bit Starter Kit

\$418



This is one of the fastest peer-to-peer networks on the market. This 16-bit Invisible Network Starter Kit includes 2 adapter cards, 25 feet of coaxial RG58 A/U cable, 2 terminators, 2 T connectors, software & hardware user's manual. This means you get an instant network on receipt. The package even includes our award-winning Windows 3.0/3.1 graphical network interface, allowing unmatched functionality within Windows 386 Enhanced or Standard mode of operation. Invisible Network #11048

Parallel Port Adaptor Coax #11050\$308

Shared Access Modem Sharing Kit

\$698



This kit gives LAN administrators reliable, easy-to-use communications resource sharing for any size LAN in a single, complete and integrated package. All cabling is included, as well as On-LAN communications software. Best of all, it requires virtually no on-going support by the LAN administrator.

- High-speed V.32bis modem (effective data throughput up to 57.6Kbps).
- Perfect for small- to medium-sized companies with moderate communications traffic.
- Incredibly easy to use, no more difficult than E-Mail.

U.S. Robotics #11203

Multimedia: For the Eyes, Ears and Mind



Multimedia Upgrade Kit Plus

\$864



This high-powered multimedia kit will set you up for Multimedia PC and Windows 3.1. You not only get the most reliable hardware, like the Pro AudioSpectrum Plus sound card and the Sony CDU-535 CD-ROM drive. You also get Windows 3.1, Compton's Multimedia Encyclopedia on CD-ROM, King's Quest V on CD-ROM, MacroMind Action! on CD-ROM, Stereo Studio F/X (sound editor), TrakBlaster Pro (music) and much more. Media Visions #10567

Pro 16 Multimedia Upgrade Kit #10592	\$998
Pro Audio 16 #10568	\$228
Portable Audio Port #10570	\$148

CDR-37 w/CD Gallery

\$548



NEC's CDR-37 offers low cost entry to Multimedia CD-ROM. Its features include a 450ms average access time, MPC compliance and more. The included NEC CD Gallery gives you everything you need—hardware, cables and speakers. And it comes with seven CDs: World Atlas, The Time Table of History, Battle Chess, The New Grolier Electronic Encyclopedia, The TIME Almanac Great Cities of the World and National Geographic's "Mammals." NEC #11121

CDR-74 Gallery External (280ms) #11122	\$778
CDR-84 Internal #11120	\$589

CIRCLE 199 ON READER SERVICE CARD

Sound Blaster Pro Basic

\$158

NEW



This cost-effective multimedia solution comes with all the features of top-of-the-line Sound Blaster Pro, stereo audio (without MIDI cabling and sequencer software), and a rich assortment of software that will make people sit up and listen. This is the perfect companion for all leading sound-enhanced applications, presentation packages and MPC authoring tools. The Sound Blaster Pro Basic is easily upgradeable to Sound Blaster Pro. Creative Labs #11204

Multimedia Upgrade Kit	
Internal #07698	\$564
Video Blaster #10728	\$344

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☒ = YES ☐ = NO

Products listed in alphabetical order	Eight-In-One for Windows	Framework XE	LotusWorks	Microsoft Works	Microsoft Works for Windows	PFS: WindowWorks	WordPerfect Works for DOS
☒ = YES ☐ = NO							
Word Processor (continued)							
Right-aligned/centered/decimal tabs	☒ ☒ ☒	☐ ☐ ☐	☒ ☒ ☐	☒ ☒ ☒	☒ ☒ ☒	☒ ☒ ☒	☒ ☒ ☒
Bullets	☒	☐	☐	☐	☐	☒	☐
Supports HP-compatible cartridge fonts	☒	☐	☐	☒	☒	☒	☒
Number of fonts supplied	None	1	4	None	None	3	None
Screen display:							
Maximum number of text lines in document display	150	75	24	60	64	150	23
WYSIWYG display	☐	☐	☐	☐	☒	☒	☒
Imported graphics	☒	☐	☐	☐	☒	☒	☒
Status indicator line:							
Page/line/column number	☒ ☒ ☒	☐ ☒ ☒	☐ ☐ ☐	☒ ☐ ☐	☒ ☐ ☐	☒ ☒ ☒	☒ ☒ ☒
Current drive and path	☐	☐	☒	☐	☐	☐	☒
Block commands:							
Copies block to another file	☒	☒	☒	☒	☒	☒	☒
Moves block to another file	☒	☒	☒	☒	☒	☒	☒
Appends block to another file	☒	☒	☒	☒	☒	☒	☒
Formats block	☒	☒	☒	☒	☒	☒	☒
Prints block	☐	☒	☐	☐	☐	☐	☒
Maximum size of block	64K	64K	Limited by disk space	Limited by disk space	Limited by disk space	64K	Limited by disk space
Search-and-replace:							
Case-sensitive	☒	☒	☒	☒	☒	☒	☒
Conditional replace	☐	☒	☒	☒	☒	☒	☒
Searches backwards	☒	☒	☐	☐	☐	☒	☒
Uses wildcards	☐	☒	☐	☒	☒	☐	☒
Direct data transfer:							
To/from database	☐ ☐	☒ ☒	☐ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ☒
To/from spreadsheet	☐ ☐	☒ ☒	☐ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ☒
To/from graphics	☐ ☐	☒ ☒	☐ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ☒
File import and export formats:							
ASCII	☒	☒	☒	☒	☒	☒	☒
DCA	☐	☒	☐	☒	☐	☐	☒
Microsoft Word	☐	☒	☐	☒	☒	☒	☒
WordPerfect	☐	☒	☐	☒	☒	☐	☒
WordStar	☐	☒	☐	☒	☐	☐	☒
Other	RTF, WPD	dBASE III, Lotus 1-2-3, MultiMate for DOS, Multiplan	None	Microsoft Works for Windows word processor	Microsoft Works word processor, RTF, Windows Write	Better Working, PFS:First Choice, RTF	.DIF, DisplayWrite, MultiMate
Tools:							
Spell-checking:							
Number of words in spell-check dictionary	100,000	80,000	120,000	100,000	100,000	100,000	80,000
Spell-checks single words	☐	☒	☒	☒	☒	☒	☐
Spell-checks defined block	☒	☒	☒	☒	☒	☒	☒
Automatic hyphenation	☐	☐	☒	☐	☐	☒	☐
Thesaurus	☒	☐	☒	☒	☒	☒	☒
Word count	☐	☐	☒	☐	☒	☐	☒

346 PC MAGAZINE SEPTEMBER 15, 1992

Giant Savings For Windows Shoppers

That's right! You can save a full 50% off the price of our new XTree® for Windows™ file and disk management software. But you have to act fast to take advantage of this \$49.95 price because quantities are limited to less than 1% of Windows users. After this special offer, XTree for Windows will sell for \$99.00.

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► SUMMARY OF FEATURES

Products listed in alphabetical order		Eight-In-One for Windows	Framework XE	LotusWorks	Microsoft Works	Microsoft Works for Windows	PFS: WindowWorks	WordPerfect Works for DOS
☒ = YES ☐ = NO								
Word Processor (continued)								
Corporate, academic, and professional features:								
Document summary	☐	☐	☐	☐	☐	☐	☐	☐
Footnotes/endnotes	☐ ☐	☐ ☐	☐ ☐	☐ ☒	☐ ☒	☒ ☒	☒ ☒	☐ ☒
Hidden comments	☐	☐	☐	☐	☒	☐	☐	☐
Indexing	☐	☐	☐	☐	☐	☒	☒	☐
Outlining	☒	☒	☐	☐	☐	☒	☒	☒
Table of contents	☒	☒	☐	☐	☐	☒	☒	☐
Database								
File structure:								
Maximum data-field size	254 characters	N/A	240 characters	256K	256K	254 characters	N/A	
Maximum memo-field size	32K	64K	64K	N/A	N/A	32K	8K	
Maximum number of fields per record	128	32,000	128	256	256	128	100	
Maximum number of records per data file	32,000	32,000	Limited by disk space	4,096	32,000	32,000	Limited by disk space	
Maximum number of open data files	1	32,000	9	8	8	1	Unlimited	
Maximum amount of EMS memory	N/A	4MB	65K	4MB	N/A	N/A	N/A	
Automatic field-name placement	☐	☒	☒	☒	☒	☐	☐	
Data field types:								
Currency	☐	☒	☒	☒	☒	☐	☐	
Boolean	☒	☒	☒	☒	☒	☒	☐	
Other	Character, date, memo, numeric	Character, date, numeric, time	Character, date, memo, numeric, percent	Date, exponential, percent, time, true/false	Date, exponential, percent, time, true/false	Character, date, memo, numeric	Character	
Direct data transfer:								
To/from word processor	☐ ☐	☒ ☒	☒ ☐	☒ ☒	☒ ☒	☒ ☒	☒ ☒	
To/from spreadsheet	☐ ☐	☒ ☒	☐ ☐	☒ ☒	☒ ☒	☒ ☒	☒ ☒	
To/from graphics	☐ ☐	☒ ☒	☐ ☐	☒ ☒	☒ ☒	☐ ☐	☐ ☐	
Data import/export formats:								
ASCII	☒	☒	☒	☒	☒	☒	☒	
.DIF	☐	☐	☒	☐	☐	☐	☒	
Other	.DBF	dBASE III, Lotus 1-2-3, MultiMate, Multiplan	.DBF	None	.DBF	.DBF	WordPerfect merge format	
Data manipulation:								
Can join data files	☒	☒	☒	☐	☐	☒	☐	
Can index fields	☒	☐	☒	☐	☐	☒	☒	
Maximum number of indexed fields	3	N/A	*	N/A	N/A	3	12	
Search parameters:								
All occurrences	☒	☒	☒	☒	☒	☒	☒	
Indexed field only	☒	☐	☒	☐	☐	☒	☐	
Multiple fields	☒	☒	☒	☒	☒	☒	☐	
Maximum number of fields	3	Unlimited	*	256	256	3	N/A	
Wildcard or string segment	☒	☒	☐	☒	☒	☒	☒	
Mathematical/statistical functions	☒ ☐	☒ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ☐	☐ ☐	
Report generation:								
Generates mailing labels	☒	☒	☒	☒	☒	☒	☒	
Paints screen	☒	☒	☐	☐	☐	☒	☒	

N/A—Not applicable: The product does not have this feature. * Limited by length restriction on index expression (100 bytes).

CONTINUES



"A Real Steal."

InfoWorld 9-30-91

"A steal." "A must-have." That's what the experts are calling new Windows Draw. The incredibly affordable, easy-to-use graphics software that lets you add visual impact to *everything* you produce!

You can create your own graphics, or choose from *thousands* of ready-made images, symbols, borders, charts and more. Use Windows Draw to add pizzazz to presentations. New life to newsletters. And flair to flow charts. It's compatible with all your favorite word processing, page layout and other PC programs. So you can add dazzle to just about everything you do!



Make everything you produce look great with dazzling graphics.

Which Would You Buy?		
Illustrator	★★★★★	\$695
Windows Draw	★★★★½	\$149
Professional Draw	★★★★½	\$495
Freehand	★★★★	\$595
Harvard Draw	★★★½	\$595
Corel Draw	★★★½	\$695

Publish Magazine June 1992.

(Suggested retail prices.)

"A beautifully designed draw program."

COMPUTE
February/March 1992

"Major Visual Impact, Minor Wallet Damage."

BYTE
January 1992

"This new software offers a serious challenge to the conventional wisdom that high functionality requires high prices. Windows Draw offers a surprisingly full array of drawing tools and functions, an extensive clip-art library, and a truly can't miss interface."

PC Computing
December 1991

"An outstanding bargain."

PC Sources
February 1992

"In fact, the program's drawing and transformation tools rank with the best. You can create text on a path, fancy gradient fills, and blends, not to mention that your drawing can be up to 55 inches square!"

Publish Magazine
June 1992

"Not only is Windows Draw great software, it's also a great bargain!"

PC Publishing & Presentations
February/March 1992

"Add performance that's second-to-none and the unbeatably intelligent and friendly design of Windows Draw's user environment, and you have everyman's illustration program."

Publish Magazine
June 1992

With reviews like these, it's no wonder Windows Draw is the #1 selling PC graphics package in America. Steal a copy for yourself today!

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CIRCLE 311 ON READER SERVICE CARD

PC EDITORS' CHOICE

☒ = YES ☐ = NO

Products listed in alphabetical order	Eight-In-One for Windows	Framework XE	LotusWorks	Microsoft Works	Microsoft Works for Windows	PFS: WindowWorks	WordPerfect Works for DOS
☒ = YES ☐ = NO							
Spreadsheet							
Maximum size (rows by columns)	32,000 x 10,000	32,000 x 32,000	8,192 x 256	4,096 x 256	16,384 x 256	32,000 x 10,000	8,192 x 256
Maximum amount of EMS memory	N/A	4MB	65K	4MB	N/A	N/A	16MB
Worksheet features:							
Named ranges	☐	☐	☒	☒	☒	☐	☒
Multiple windows	☐	☒	☒	☒	☒	☐	☐
Hidden columns	☐	☒	☒	☒	☒	☐	☒
Cell protection	☐	☒	☒	☒	☒	☐	☒
Spreadsheet merge	☐	☒	☐	☐	☐	☐	☒
Maximum number of open spreadsheets	1	32,000	9	8	8	1	Unlimited
Direct data transfer:							
To/from word processor	☐ ☐	☒ ☒	☒ ☐	☒ ☒	☒ ☒	☒ ☒	☒ ☒
To/from database	☐ ☐	☒ ☒	☐ ☐	☒ ☒	☒ ☒	☒ ☒	☒ ☒
To/from graphics	☐ ☐	☒ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ☒
File import/export formats:							
ASCII	☒	☒	☒	☒	☒	☒	☒
.DIF	☐	☐	☒	☐	☐	☐	☐
.WKS/.WK1	☒ ☒	☒ ☐	☐ ☒	☒ ☒	☒ ☒	☒ ☒	☐ ☒
Other	CSV, Eight-In-One for DOS	Multiplan	None	Multiplan	Multiplan	Eight-In-One	PlanPerfect, WordPerfect
Spreadsheet functions:							
Includes date and time	☒	☒	☒	☒	☒	☒	☒
Includes financial computations	☒	☒	☒	☒	☒	☒	☒
Includes logic	☒	☒	☒	☒	☒	☒	☒
Sorting by row/column	☐ ☐	☒ ☐	☒ ☒	☒ ☒	☒ ☒	☐ ☐	☒ ☒
Number of math/analytical functions	42	182	80	57 (and 4 operators)	57 (and 14 operators)	42	102
Printing:							
Can print shaded cells	☒	☐	☐	☐	☐	☒	☐
Can create boxes	☒	☐	☐	☐	☒	☒	☐
Prints in landscape mode	☒	☒	☐	☒	☒	☒	☒
Prints defined range	☒	☒	☒	☒	☒	☒	☒
Graphics							
Built into spreadsheet	☐	☐	☒	☒	☒	☐	☒
Standalone module	☒	☒	☐	☐	☐	☒	☒
Maximum amount of EMS memory	N/A	16MB	65K	4MB	N/A	N/A	32MB
Direct data transfer:							
To/from word processor	☐ ☐	☐ ☐	☐ ☐	☒ ☐	☒ ☐	☒ ☐	☒ ☒
To/from database	☐ ☐	☒ ☒	☐ ☐	☒ ☒	☒ ☒	☐ ☒	☐ ☐
To/from spreadsheet	☐ ☐	☒ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ☒
Dynamic links to spreadsheets	N/A	☒	☒	☒	☒	☒	☐
Graph export formats	None	None	None	None	None	None	.WPG
Chart types:							
Area	☒	☐	☐	☐	☐	☒	☒
Horizontal bar	☒	☐	☒	☐	☐	☒	☒
Line	☒	☒	☒	☒	☒	☒	☒
Pie	☒	☒	☒	☒	☒	☒	☒
Vertical column	☒	☒	☒	☒	☒	☒	☒

CONTINUES

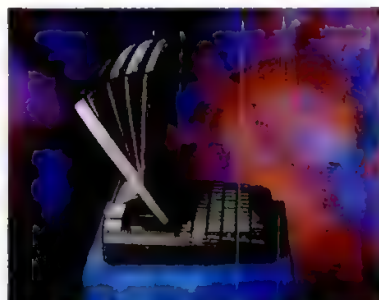
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"When it has to work right"

[illegible]

CODE A4815

► SUMMARY OF FEATURES

Products listed in alphabetical order							
■ = YES □ = NO							
	Eight-In-One for Windows	Framework XE	LotusWorks	Microsoft Works	Microsoft Works for Windows	PFS: WindowWorks	WordPerfect Works for DOS
Graphics (continued)							
Other	High-low-close, scatter, stacked bar	Combination, high-low-close, scatter, stacked bar, x,y graph	Exploded pie, stacked bar, x,y graph	Combination, high-low-close, scatter, stacked line	Combination, high-low-average, scatter, stacked line	Exploded pie, high-low-close, scatter, stacked bar	Area, combination, exploded pie, pie, stacked bar
Automatic legends	■	■	■	■	■	■	■
Drawing tools	■	■	□	□	■	■	■
Graphics manipulation	■	■	■	□	■	■	■
Multiple y axes	□	□	□	■	■	□	□
Communications							
Automatic redial	□	■	■	□	■	□	■
Unattended file transmission	□	■	■	□	□	□	■
Phone book	■	■	■	□	□	■	■
Modem support:							
Modem transmission rates	All	All	All	All	All	All	All
Hayes extended command set	■	■	■	■	■	■	■
File-transfer protocols:							
ASCII	■	■	■	■	■	■	■
Kermit	□	■	■	□	■	□	■
Some version of Xmodem/Ymodem	■ ■	■ ■	■ ■	■ □	■ □	■ ■	■ ■
Other	None	Crosstalk, Smartcom	None	None	None	None	Zmodem, Zmodem recover

ENDS

how to take advantage of the template files, which help you learn quickly how to use Microsoft Works and give you a head start with some useful applications. Two spreadsheet templates help you track your budget and amortize a loan; others let you balance your checkbook, build an address list, and organize an inventory.

TUTORIAL WORKS

The program also comes with a great on-line tutorial that covers every aspect of Microsoft Works. You can access the tutorial at any point, which means you can go off and learn how to perform an operation in the middle of your work. Backing up Microsoft Works' learning tools is a fine help system.

In addition to the main modules, Microsoft Works offers file management tools, a calculator, and an alarm clock. The file management tools, in particular, are quite useful. They let you stay within Microsoft Works while you copy, delete, or rename files, create and remove directories, or format a disk. You can also run other programs from within Microsoft Works and place them on a dialog box list.

WORDWORKS

Using Microsoft Works' word processor, we arranged and formatted text easily. Besides the usual copy and move commands, Microsoft Works has one called Copy Special. This command let us copy character or paragraph formats and apply them wherever we wanted. We also found extensive controls for selecting type size, style, and face.

The integration between the word processor and the other program modules is quite good. With just a few keystrokes, we were able to move text, data, and charts from one module to another.

DECENT SPREADSHEET

As spreadsheets go, the one in Microsoft Works is fairly standard yet solid. It is limited to 4,096 rows by 256 columns, and you get 57 functions, a good array of format types, and quick, easy copy, move, and fill commands.

Microsoft Works makes charting as easy as highlighting a range and selecting New Chart from the View menu. After the new chart appears, you can change the chart type (a basic set is available)

SUITABILITY TO TASK

Microsoft Works

	POOR	FAIR	GOOD	EXCELLENT
Word processing	●	●	○	○
Database	●	●	●	○
Spreadsheet	●	●	●	○
Communications	●	●	○	○
Integration	●	●	●	○
Portability	●	●	●	○

through the Format menu and add legends and titles. One surprising deficit of the spreadsheet is that it cannot import .XLS files. They must be saved as .WKS files in Excel in order for Microsoft Works to handle them.

WEAKER POINTS

The database module is limited to 4,096 records. This may not even be large enough for a small business. But the functionality in the database area is good. Creating fields is done simply by typing on-screen and placing a colon after the field name. Fields are immediately active, so you can enter data before you are done

Low-Cost Integrated Software

designing the form. You get a wide enough selection of field types for most applications. You can create calculated fields and control fonts and character styles. In addition, moving between form and list (table) view is easy and makes finding records using wildcards simple. Microsoft Works uses the same report approach as that of Microsoft Works for Windows: You select New Report to bring up a form, which you can then customize. Microsoft Works sorts on up to three fields at a time in any order. It offers no indexing ability, however.

The communications module is about as basic as you can get. It supports baud rates up to 9,600 bits per second and uses the Hayes command set. For file transfer, you only get ASCII and Xmodem protocols. The module will not handle unattended transmissions, and it can't even automatically redial a phone number.

IN THE WORKS

In the fall, Microsoft plans to release Version 3.0 of Microsoft Works. It will be a major upgrade that will bring the product much closer to the Windows version. It will include several WorksWizards (guided routines for accomplishing tasks with the program). The program will also more closely resemble its Windows cousin, using three-dimensional dialog boxes and buttons.

The spreadsheet will be four times as large, with 16,384 rows; the database limit

will jump to 32,000 records. These new limits match what Microsoft Works for Windows offers.

Another major enhancement will be a calendar function. It will offer day views with notes and a month view. You will be able to set reminders and see conflicts. Other new functions will include the ability to insert graphics in a document (although you will only be able to view them through page preview), and the use of Xmodem, Ymodem, and Kermit protocols in the communications module.

FINAL WORD

While its Windows sibling has jostled it out of Editors' Choice territory, Microsoft Works is still an excellent package and clearly a prime contender in the DOS market. Its easy-to-use graphical interface and solid, consistent features make it a fine choice for the small business or home office. It will doubtless be an even better choice in its next incarnation.

Microsoft Corp.

Microsoft Works for Windows, Version 2.0

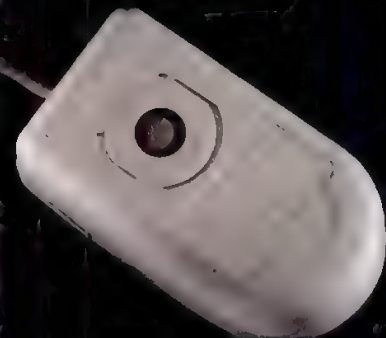
BY HENRY FERSKO-WEISS

WorksWizards, toolbars, an on-line tutorial, and a totally graphical personality make Microsoft Works for Windows, Version 2.0, captivatingly easy to learn and use. The only way you can get lost in this program is if you blow your CRT. Works for Windows also offers solid features in all its modules. For computer novices and more experienced general business users alike, this looks like an outstanding software package.

The program consists of a word processor, a drawing utility, a spreadsheet with built-in charting tools, and a database, all for \$199. It does *not* contain a communications module or desktop facilities, a conscious decision on the part of Microsoft, since Windows comes with its own communications program (Terminal) and a number of desktop utilities, including File Manager. While the resulting package perhaps isn't quite as seamlessly



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SUITABILITY TO TASK

Microsoft Works for Windows

	POOR	FAIR	GOOD	EXCELLENT
Word processing	☒	☒	☒	☐
Database	☒	☒	☒	☐
Spreadsheet	☒	☒	☒	☐
Communications	N/A			
Integration	☒	☒	☒	☐
Portability	☒	☒	☐	☐

integrated as it might be if all the components were built-in, it does offer as compensation an extended range of integration with other Windows applications, either through OLE or the Windows Clipboard.

Works for Windows' on-line tutorial covers every aspect of the package thoroughly, making it possible to master the basics for all the modules in just a few hours—even if you have never used a Windows product before. Help buttons abound in every dialog and alert box.

INTERFACE OVERVIEW

In addition to menus, Works for Windows utilizes a toolbar equipped with icon buttons to initiate frequently used commands. We were able to do extensive work without ever opening a menu. Common to all the modules are buttons to change the size, style, and typeface of text, set text alignment, access print preview, and print a document. Each module has buttons specific to its work. Thus the word processor has buttons to select line spacing and to launch the spell-checker and the thesaurus. The spreadsheet provides buttons to automatically sum rows and/or columns of numbers and create charts.

In addition, Works for Windows comes with automated routines called WorksWizards, which lead you through procedures needed to create your own applications, such as an address book, form letters, and mailing labels, and do the final work for you.

As you might expect of an up-to-date Windows application, Works for Windows supports hot linking (also known as dynamic data exchange) between its modules. Thus, for example, if you create a standard monthly business report and embed in it a chart created in the spreadsheet module and linked to specific data

cells, updating the spreadsheet numbers monthly will result in an updated chart in your report document.

Works for Windows' three basic modules all offer solid functionality. The word processor gives you extensive control over document typography using scalable ATM or TrueType fonts, and flexible formatting using the aforementioned task buttons plus drag-and-drop tab setting. Ancillary utilities include spell-checking, word finding, word count, and a drawing utility that can generate pictures, text borders, and the like. The word processor converts files from Word for Windows, WordPerfect, and Windows Write. A Note-It utility lets you create nonprinting notes.

The spreadsheet offers an impressive maximum grid size of 16,384 rows by 256 columns (the same size as Excel). We found it easy to enter text, numbers, and formulas and to apply all the standard numerical formats (such as currency, fixed decimal, and exponential). Moving cells and ranges around is amazingly simple in Works for Windows; it involves a short series of keystrokes that takes longer to explain than to do. To split the screen (which you can also do in the other modules), simply drag a graphical divider to the desired location on the screen.

Works for Windows' charting facility lives within the spreadsheet module. We created a chart simply by highlighting a group of cells and clicking the chart button; the program instantly created a bar chart (the default). To change to a different type of chart, we just picked and clicked the appropriate pictorial button in the chart utility. We were able to customize our charts easily and extensively as well, entering titles and legends, choosing colors, formatting the axes, and the like.

GROWN-UP DATABASE

The database in Works for Windows has a generous upper limit of 32,000 records—more than enough for most business applications—and the interactive, drag-and-drop graphical interface makes it incredibly easy to use. To create data-entry forms, for example, you simply type a field name anywhere on the screen, followed by a colon. A dialog box pops up to let you size the field, and you're done.

The program's tabular view is completely independent of form view, so you

can move columns around without worrying about changing the layout of the form or scrambling your data. Columns can be resized interactively on-screen by dragging a column divider.

Reports are initiated by a special task button on the toolbar that automates the process amazingly. After clicking, you enter a title, choose database fields from a list box, use check boxes to select statistical operations, and voila!—you've got a report. (You can use all the mathematical and analytical functions available in the spreadsheet to create calculated fields in Works for Windows database reports.) After the basic report is created, you can dress it up by tweaking the layout, headings, and so on.

There are a number of other "little" features that make Microsoft Works for Windows a pleasure to use. For example, a Save Workspace command lets you save all open files together so you can recall them and pick up work exactly where you left off.

In addition to all the ease-of-use and learning features and the solid functionality, you have the advantage of running under Windows. For one thing, this lets you embed objects in a word processing document from any Windows application that supports OLE. It is also easy to copy and paste between Works for Windows and other applications. For all these reasons, this is an excellent program for small businesses.

FACT FILE

Microsoft Works for Windows, Version 2.0

Microsoft Corp., One Microsoft Way,
Redmond WA 98052; 800-426-9400, 206-
882-8080; fax, 206-936-7329

List Price: \$199.

Requires: 1MB RAM, DOS 3.1 or later, Microsoft Windows 3.0 or later. Mouse recommended.

In Short: This program offers very solid word processing, spreadsheet, graphics, and database functionality. The WYSIWYG displays combined with the Windows interface and a host of ease-of-use features make this program extremely easy to learn and fun to use. Automated routines called WorksWizards actually lead users through a sampling of projects and automate most of the work. You can't go wrong with this program.

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Low-Cost Integrated Software

Works for Windows also comes in a multimedia edition, for the same \$199 price. The two packages have exactly the same functionality, but the multimedia edition incorporates digital sound, animation, and pictures in the tutorial and reference. The tutorial has the same number of lessons, covering the same topics, but it is presented with multimedia effects.

The first productivity application from Microsoft to use multimedia capabilities, the multimedia edition of Works for Windows is distributed only on a compact disc, so its hardware and software requirements are different. To run the application, you will need to meet the MPC's base specifications, which include a 386SX-based machine; 2MB RAM; a 30MB hard disk (the package only takes up 4MB of hard disk space); VGA or better graphics; a CD-ROM drive with an access time of less than one second and a transfer rate of 150K per second; an audio board, speakers, or headphones; a mouse; Microsoft CD-ROM Extensions 2.2 or later; and Windows 3.0 with Multimedia Extensions 1.0, or Windows 3.1.

Spinnaker Software Corp.

PFS:WindowWorks, Version 1.1

BY GARY BERLINE

Spinnaker Software Corp. builds its \$149 PFS:WindowWorks, Version 1.1, around a word processor that displays some real flashes of brilliance; however, the spreadsheet leaves something—and the database leaves much—to be desired. The implementation of the product as a whole, and particularly with respect to Windows, could also stand some smoothing. Hence, we look forward to the release of Version 2.0, which is due out by the time you read this but was not available in time to be reviewed here.

The current product lives in Windows a little like an immigrant—excited by a new land but not fully accustomed to its strange ways. We found facilities for dragging and dropping design elements but no visual means for positioning them accurately. Instead, you are forced to work with dialog boxes, entering numbers to set

element positions. Pursuing a sort of halting "Windowsness," the software also forces you to open files in the modules where you created them, rather than granting access from anywhere inside PFS:WindowWorks and launching the appropriate application for you. The word processor allows you to open up to four documents at once, but you hit a one-file ceiling in every other module. In contrast, Microsoft Works for Windows lets you open eight windows, running any program combination.



Finding your way around PFS:WindowWorks isn't exactly difficult, but it is frustrating to find that menu headings change radically across modules. Further, the package needs far better tutorial, help, and reference facilities.

You won't find all the features of a high-end, standalone product in the word processor, but then you wouldn't expect to in a \$149 package. We were surprised,



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Low-Cost Integrated Software

however, by the number and scope of unexpected extras—from manual kerning (nice, but hardly essential) to text-wrap around graphics (a powerful ability not found even in Microsoft Works). Strong graphics manipulation features let you easily drop in, move, and resize bitmaps, charts, and spreadsheets. And while PFS:WindowWorks does not support OLE or DDE, inserted charts and spreadsheets do enjoy automatically or manually refreshed links. Styles and templates, adjustable hyphenation, and a thesaurus that defines words and presents usages expand your document-creation capabilities. Positioning form letter field names (from a database or the address book) involves little more than selecting them from a list. A Collapse White Space option eliminates extraneous blanks. A word-counter would round out those features already oriented toward academia, that is, outlining, index creation, and the table-of-contents generator.

Strangely, the program cannot print selected text—only full pages. The limited drawing facility also needs an upgrade. It

SUITABILITY TO TASK				
PFS:WindowWorks				
	POOR	FAIR	GOOD	EXCELLENT
Word processing	●	●	●	○
Database	●	●	○	○
Spreadsheet	●	●	○	○
Communications	●	●	○	○
Integration	●	●	●	○
Portability	●	○	○	○

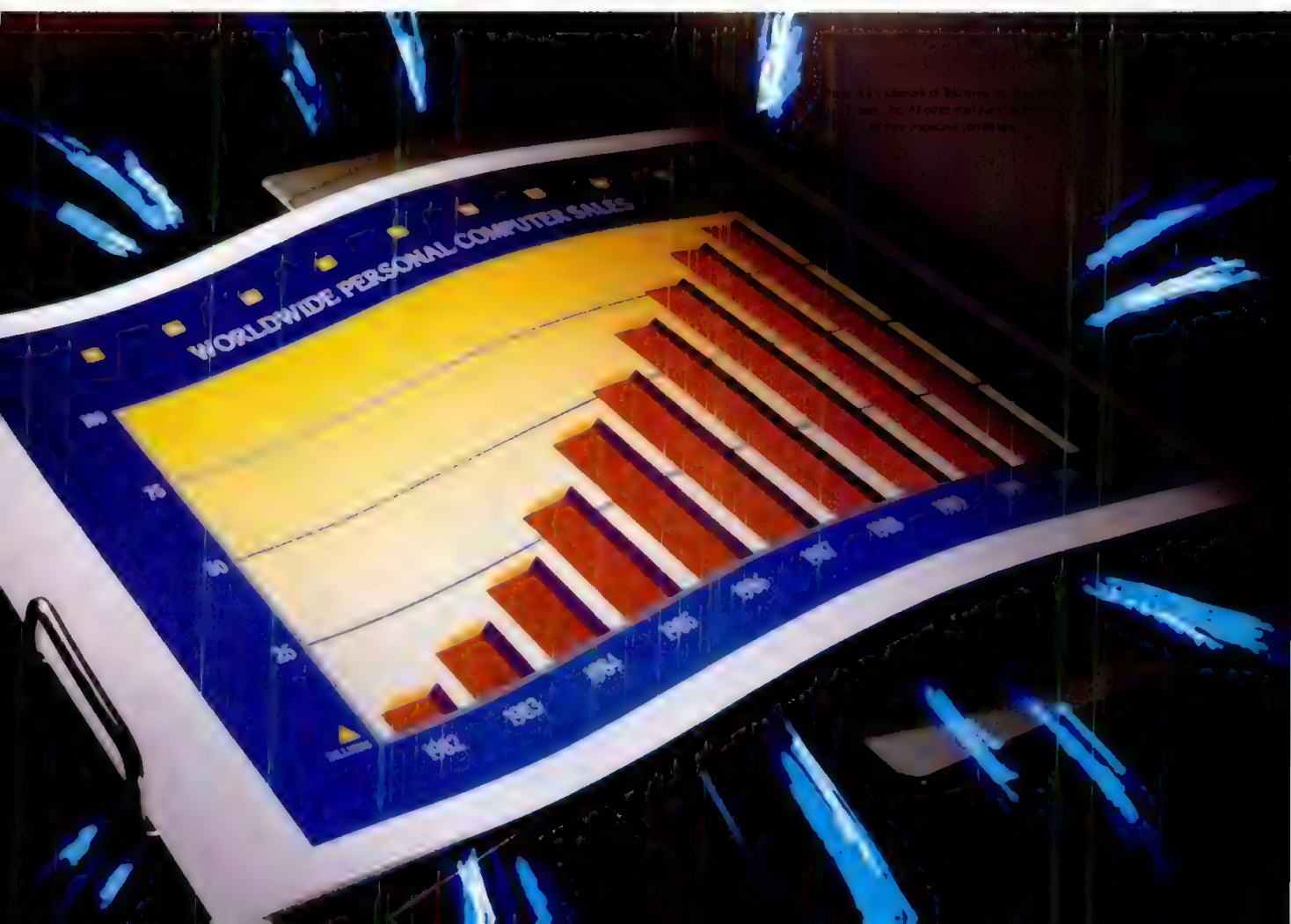
is basically only good for drawing rules, boxes, and circles.

Spinnaker includes Publisher's Powerpak, Version 1.5, which provides scalable screen and printer fonts to supplement any Windows-compatible fonts you might have. The release of PFS:WindowWorks we tested couldn't recognize TrueType—a problem for which Spinnaker created an interim version, 1.3 (or 1.25 for owners of the OEM version), that will roll out before you read this. We looked at a final beta which worked fine, and presumably this problem will stay fixed in Version 2.0.

The impressive maximum size of PFS:WindowWorks' spreadsheet—32,000 rows by 10,000 columns—may set up expectations that the rest of the module fails to fulfill. We were disappointed, to say the least, at the spreadsheet's lack of a sort feature (since this is one of the most common operations in spreadsheet usage). Similarly lacking are formula creation tools, such as a pick list. The program can import .WK1, .WKS and comma-delimited ASCII files (and had no trouble with any of ours), but ignores Excel's .XLS format—another curious gap for a Windows product. Good font support in the spreadsheet makes the single take-it-or-leave-it shading option a mystery, particularly considering that the word processor supplies 19 shadings. The charting module supports nine types of plots. It offers some flexibility in scaling, but almost none in label or legend placement.

We did sneak preview the spreadsheet module destined to go into Version 2.0, though. It appears to address most of the current module's deficiencies.

Some frustrating limitations mar



Low-Cost Integrated Software

FACT FILE

PFS:WindowWorks, Version 1.1

Spinnaker Software Corp., 201 Broadway,
Cambridge, MA 02139; 617-494-1200; fax,
617-494-1219

List Price: \$149

Requires: 1MB RAM (1.5MB recommended), DOS 3.1 or later, Microsoft Windows 3.0 or later. Mouse recommended

In Short: PFS:WindowWorks' simple but solid word processor performs more than just the basic functions and shows good connections to the product's other modules. The spreadsheet and database offer adequate functionality but need the kind of attention that is evident in the word processor. Tighter Windows integration will give the package a boost too, but even now it represents a reasonable value for those whose needs mostly involve document processing.

547 ON READER SERVICE CARD

verted the contents of a database field (we multiplied its contents by minus 1). Even this was ineffectual, however, as when we did searches on the descending-order file, the program returned search results in the original uninverted order.

The tools for building data entry screens and generating reports are minimal. Neither supports user-selectable fonts, for instance. While we were able to create calculated, restricted-input, and normal fields and index up to three in the database itself, only one index at a time can be active. The interactive search facility allows searches on a single field only, using a single fixed criterion or logical comparison. While a database aiming for ease of use should include QBE (query by example), we didn't find it here. Printed reports, at least, let us specify a range of records and offered a little more flexibility in the number of fields and criteria, but they also remain far too restricted. For example, report formatting gives you only limited control over page layout.

The address book, which masquerades as a full-fledged module, is little more

than a database template. Its lack of a dialing feature makes it of little value. The telecommunications terminal component does slightly better, offering a phone directory and script language. A label maker (which also addresses envelopes) ranks as genuinely useful.

PFS:WindowWorks puts solid, easy-to-use word processing in your hands without emptying your pockets. Like its lower-priced sibling, Eight-In-One for Windows, the word processor is the showcase application in the suite. The limited spreadsheet and database functionality add some value, but if these applications figure heavily in your working needs, look elsewhere, or wait for the next release.

WordPerfect Corp.

WordPerfect Works for DOS, Version 1.0

BY ROBERT KENDALL

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PFS:WindowWorks' database. Amazingly, it can't index records in descending order, for example. To produce a descending-order index during our testing, we in-

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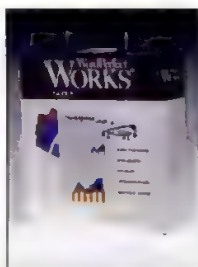
cessor, but also a drawing package and a spreadsheet, it is logical that the company should make these the basis of an integrated package. The \$159 WordPerfect Works for DOS, Version 1.0, combines Letter Perfect (WordPerfect's "lite" word processor) with scaled-down versions of DrawPerfect (here called the Graphics Editor) and PlanPerfect, plus simple database and communications modules, all bound together by an attractive shell. The result is solid functionality in most areas and an appealing overall environment.

All the modules share a pull-down-menu interface familiar to WordPerfect users. It may not be quite as elegant or easy to learn as a GUI, but it gets the job done efficiently. Copious context-sensitive help flattens out the learning curve, and a help index doubles as an alphabetical menu for accessing any feature.

The program's character-based approach, though somewhat old-fashioned today, has a couple of big advantages for laptop users: A mouse is not required (though the package makes full use of one if you have it), and hardware and disk space requirements are very modest.

The nice task-switching shell that binds the package together includes a customizable menu for the WordPerfect Works modules. You can add your own applications, utilities, batch files, or macros to the menu options. Switching among active applications is an effortless procedure, and the program will swap code to disk or EMS as necessary. The look of the shell is essentially unchanged from WordPerfect Executive; long-time users will feel at home.

Apart from the absence of a number of features, the word processor's interface is nearly identical to WordPerfect's. You can also transfer documents to and from WordPerfect without the loss of any formatting. In our tests, the word processor handled with aplomb all the standard formatting and editing tasks we threw at it; its spelling-checker and thesaurus are small but flexible. The WordPerfect Works word processor can even tackle simple DTP chores, though without much finesse: You can place .WPG graphics in



your documents, but positioning and sizing them is awkward, and the line-and-box-drawing tool is very limited.

Working with complex formats was not much fun, since there are no stylesheets and you can't perform a search-and-replace on formatting codes. The module also lacks advanced layout capabilities, like multiple columns or footnotes. A separate utility converts documents to and from a variety of popular word processing formats.

Toggleing on a print preview gave us a near-WYSIWYG view of our document, including embedded graphics. We could zoom in and out, and even swap foreground and background colors for easier viewing on some LCD screens.

BASIC SPREAD

The spreadsheet should meet most business needs. We didn't find slick auditing or goal-seeking features, but most types of formula functions are well-represented, user-defined functions are supported, and the package imposes no serious limitations on formula complexity. We were able to specify different fonts for different ranges in our test documents, and the graphical print preview showed us how they would look on the page. Although WordPerfect Works' spreadsheet module uses PlanPerfect as its native file format, Lotus 1-2-3 is supported as well.

A charting component built into the spreadsheet quickly and easily turns out reasonably attractive bar, line, area, pie, or combined charts. Sensible predefined settings save you time and effort in laying out elements such as titles and legends.

When we wanted to touch up a graph, we could easily bring it into the graphics editor and manipulate all chart elements individually. All the standard drawing tools are there, including arrows, group/ungroup, and bring-to-front/back. We

SUITABILITY TO TASK

WordPerfect Works for DOS

	POOR	FAIR	GOOD	EXCELLENT
Word processing	●	●	●	○
Database	●	●	○	○
Spreadsheet	●	●	●	○
Communications	●	●	●	○
Integration	●	●	●	○
Portability	●	●	○	○

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SOFTWARE

Low-Cost Integrated Software

found the nonstandard methods for moving and resizing objects a little annoying, though; they require you to select the object and then click on Move or Resize.

Also, the editor will read only .WPG files. For other formats, we had to turn to a conversion utility that will transform most standard formats into .WPG files, though it doesn't support .BMP or .WMF.

DATA DEPRIVED

The weakest link in this ensemble is the database. It's little more than a front end for the word processor's mail-merge feature; its native format is the word processor's mail-merge address file format.

Getting external data into the program was a problem during our tests, since it won't import any standard database formats. We came up with a couple of workarounds (loading a comma-delimited ASCII file and performing a search-and-replace to change the commas and carriage returns into mail-merge codes was one), but this struck us as cruel and unusual punishment.

Further, the database allows only character fields, and thus can't perform calculations or queries using numeric or date operators. You can create customized data-entry forms and sort on multiple fields, but the program uses the brute-force method of physically sorting records rather than indexing. Finally, the report generator allows little more than printing the contents of selected records.

WordPerfect Works' mail-merge function, on the other hand, is quite robust, and can even prompt the user for input during a merge. Predefined setups for different sizes of mailing labels and envelopes is another plus.

If you have a good collection of fonts built into your printer, you will appreciate the excellent use that the WordPerfect Works' word processor and spreadsheet make of them. You can also add Bitstream FaceLift fonts. The graphics and charting modules can use only a small set of soft fonts included with the program. Unfortunately, those same fonts are inaccessible to the other modules.

WordPerfect Works' flexible communications module supports many protocols and makes it easy to create an autodialing phone directory. Each entry provides a table where you can enter commands for logging on to BBSs—an

FACT FILE

WordPerfect Works for DOS, Version 1.0

WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; 800-321-3512, 801-225-5000; fax, 801-228-5077

List Price: \$159.

Requires: 400K RAM (512K recommended), DOS 3.0 or later.

In Short: WordPerfect Works for DOS combines attractive word processing, spreadsheet, graphics, and communications modules with a rather weak database. A highly consistent interface and a nice task-switching shell add to the appeal.

ON READER SERVICE CARD

easier method than conventional script writing. The database module also provides a predefined phone book (or lets you create your own) from which you can autodial.

WordPerfect Works gets good marks for overall integration of components. With a few keystrokes we were able to copy and paste just about any data directly from one module to another. Not only can you insert charts or objects from the graphics editor into a text document, but a block of spreadsheet cells copied in instantly becomes an editable table. A spreadsheet cell can be a database record or a heading in graphic image.

The program's macro language lets you record any keystrokes, including ones that switch among different modules. You cannot edit macros, however, unless you purchase a separate macro editor.

If your budget won't accommodate the hardware demanded by a GUI, or if you want to take to the road without a mouse, WordPerfect Works is an excellent option. If you can live with the limitations of its database, you will love its highly consistent interface, productivity-enhancing shell, and easy data integration. □

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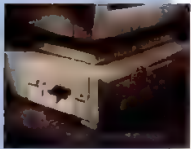
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40X/33	Intel 486/DX-33 MHz 128K Aux. cache	8	210	1024x768 1MB video RAM .28 14" Non-interlaced Multisync Color Monitor	\$2,599 \$96/mo*



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486SX/25	Intel 80486SX-25 MHz Built-in 8K CPU cache	2 standard 32 max	80	1.2 & 1.44	16 bit SVGA card 14" 1024x768 SVGA Color Monitor	\$1,299 \$48/mo*
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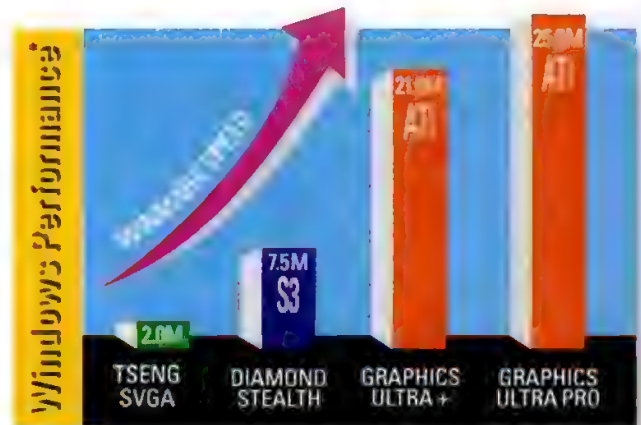
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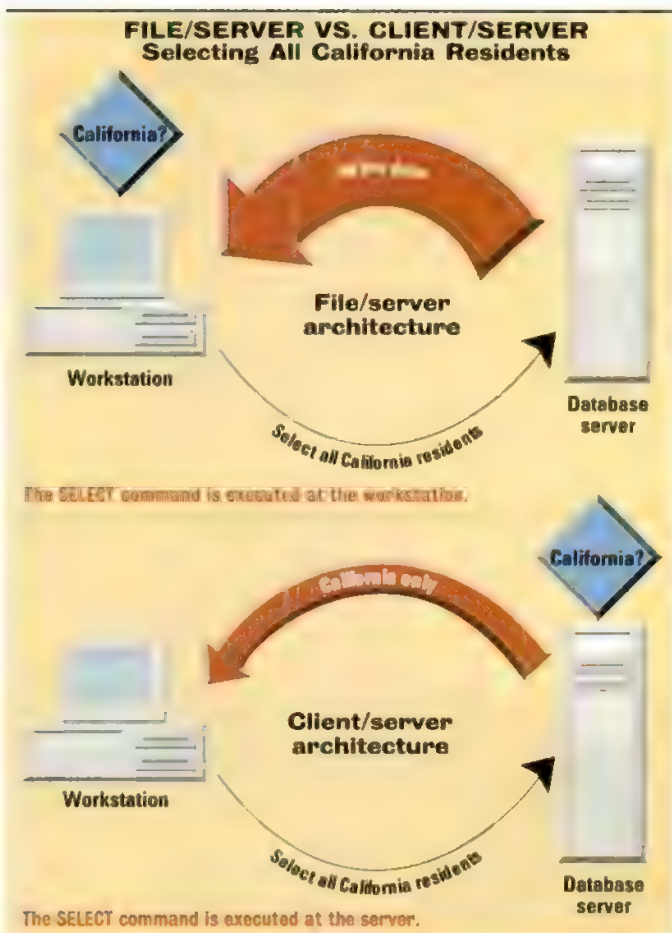


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SQL DATABASES

High-Powered, High-Priced

SQL is well on its way to becoming the lingua franca of databases. In the world of relational client/server databases, SQL is your only choice. But which product to choose?



More than any other abbreviation in this acronym-happy industry, SQL (pronounced "sequel" and standing for *structured query language*) is something of an enigma. The language of choice for accessing relational databases, SQL epitomizes elegance and simplicity. Yet, the implementation of a well-tuned client/server SQL data access system is an enormously complex undertaking.

SQL databases can be a pain to install and support and they can cost you an arm and a leg, but when it comes to data integrity and security, a SQL database is

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by Ron Anderson

Suitability to Task:**SQL Databases**

SQL databases should provide a stable environment for storing mission-critical data. The package should also have sufficient speed to support many concurrent users.

Mission critical rates the package's suitability for situations in which data integrity and system reliability are the key concerns. The score rates the database system's referential integrity components, security features, and backup and recovery systems, as well as the product's ability to implement integrity-related processes solely on the back end.

SQL programming evaluates the flexibility and comprehensiveness of the package's application development features. We consider compatibility with various levels of the SQL specification, the product-specific SQL enhancement provided, and whether APIs and preprocessors are available for 3GL languages. The score also takes into account optimization techniques.

Connectivity and portability quantify the product's suitability for distributed database environments. For connectivity, the breadth of support for gateways to minicomputer and mainframe systems is considered, along with the presence of features such as two-phase commit, distributed recovery and distributed deadlock

matchless. If your data *must* be secure and accessible around the clock you should consider a SQL database.

Originally the province of the mainframe world and then of the Unix world, SQL databases have migrated to the PC over the last few years and now run under DOS, OS/2, NetWare, and Unix. DOS-based SQL databases, which are primarily used for small, lightly used databases or standalone development work, are not covered here. The world of Unix-hosted SQL databases is vast enough to warrant separate treatment, so we confined our

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SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Mission-critical tasks	●	○	○	○
SQL programming	●	●	○	○
Connectivity and portability	●	●	●	○
Data storage	●	●	●	●
Transaction processing	●	●	●	●

detection. Portability is measured by the number of platforms supported by the package and the consistency of features across platforms.

Data storage evaluates the basic storage architecture of the system, including features such as disk spanning and striping, hashed index support, and asynchronous I/O capability. The number of import and export formats supported is also considered, along with image data support and distributed processing capabilities such as cross-device table joins and the ability of the server to send queries to another server.

Transaction processing evaluates the product's suitability for on-line transaction processing where many users are reading or updating the data at all times. Heavy emphasis is placed on locking granularity and the type of read consistency implemented. Support for on-line backup and the product's method for handling deadlock situations are also taken into account.

testing to include OS/2- and NetWare-hosted SQL databases. Reviewed here are products from Gupta Technologies, IBM, Ingres, Microsoft, Novell, Oracle, and Sybase. XDB Systems did not want its current version reviewed because it is about to release a major upgrade. For a glimpse at Unix-hosted SQL databases, see the sidebar "Unix Means Scalability and 32-Bit Performance."

Client/server products cost significantly more than file/server products (see "Multiuser Databases" in the March 31, 1992, issue of *PC Magazine*), so they are

not for those on a shoestring budget. But the speed, scalability, and data security features of client/server databases are far superior. SQL databases are most suitable for the mission-critical data a business depends upon, and thus their purchase represents a major commitment to a single vendor's product, philosophy, platform, and support. We examine these aspects in this issue. Equally important is the vast array of front-end tools for accessing SQL databases. These will be reviewed in our next issue.

THE SMARTER WAY

The smarter the database, the less the front-end programmer has to worry about. Intelligence on the database server, the so-called "back end," is what distinguishes the client/server model from the file/server model. In the file/server model, the network file server makes the database files available to each workstation, but its participation ends there. For example, if you used a file/server database to retrieve the records of all people living in California, the file server would transmit the entire database table across the network and it would be left to the workstation to determine which records satisfied the query. This can burden the network tremendously.

In the client/server model, the server plays a more active role; there is intelligence in the back-end software. Network traffic is reduced because the server processes queries and then sends the client what it needs and nothing more. The server can also control access to sensitive data with a high degree of granularity, which provides better security than the file/server architecture can. Moreover, SQL databases provide myriad features for protecting the integrity of your data.

While both NetWare and OS/2 2.0 support 32-bit operations, all of the OS/2-hosted SQL databases we looked at are currently based on the 16-bit OS/2 1.x API (application programming interface). All the NetWare-hosted SQL databases we reviewed were true 32-bit applications.

There are other fundamental differences between the two platforms. SQL databases designed as NetWare Loadable Modules (NLMs) tend to be faster than those that run under OS/2. One reason is that they are dynamically linked to

and become part of the operating system; there is no layer of software between the application and the hardware. But a misbehaving NLM can crash the entire system. On the OS/2 platform, the operating system sits between the hardware and applications, servicing requests for resources. The mediation of the operating system adds overhead and so exacts a speed penalty, but it does protect against ill-behaved applications.

Another reason NLMs are faster is that NetWare is nonpreemptive; each process is allowed to run to completion, uninterrupted. It is the responsibility of the NLM to release control of system resources at convenient times to give other processes access to those resources. In fact, this is a formal requirement for Novell certification of NLMs. OS/2, on the other hand, is a preemptive operating system: OS/2 has responsibility for managing system resources. There is nothing to prevent OS/2 from interrupting a process at an inconvenient time, thereby slowing the completion of the process. The difference between the two approaches boils down to speed versus safety.

ENHANCING THE POWER OF SQL

SQL is a terse, specialized language. With just a few commands, it lets you accomplish what would take dozens of lines of code in Xbase. This alone makes SQL a good choice for a networked environment, since it means less network traffic. But SQL is also especially well suited for extracting data from a relational database, since that is what it was designed to do; it was developed in conjunction with the relational database paradigm (see below). One key feature of SQL is that you ask the database for what you want; how to get it is left to the database software. This insulates users from changes in the database design which may occur over time.

The American National Standards Institute (ANSI) published a standards document for the SQL database language first in 1986, and more recently in 1989. The current ANSI standard for SQL specifies two levels of compatibility: ANSI SQL Level 1 and ANSI SQL Level 2, which is a superset of Level 1. Additionally, the standard specifies a separate integrity enhancement addendum. The



EDITORS' CHOICE

• Sybase SQL Server for NetWare

For its state-of-the-art feature set and blinding speed, Sybase SQL Server for NetWare wins our Editors' Choice. The product supports on-line backup, stored procedures with control logic, server-based referential integrity through triggers, and more.

Although Microsoft SQL Server (for OS/2) has virtually the same feature set as the Sybase product, the two are by no means interchangeable; platform makes a dramatic difference. Microsoft SQL Server is much slower and much less expensive, making it best suited for smaller companies or development work.

Gupta Technologies' SQLBase Server NLM earns an honorable mention. Though it lacks some of SQL Server's features (such as stored procedures and triggers), SQLBase has some features that SQL Server lacks, including declarative referential integrity and true backward-scrollable cursors. Since third-party front-end

support is relatively light, SQLBase is a good choice for companies without an existing database.

Although the feature sets and performance of the remaining products in this roundup didn't match those of the Sybase and Gupta products, each has a place, depending on your needs. IBM Extended Services with Database Server for OS/2 is a good product for true Blue shops, Oracle Server for NetWare is a good choice for large companies with databases on many platforms, and Novell's NetWare SQL is especially well suited for companies that rely heavily on Btrieve.

We recommend waiting for the release of Version 6.4 of Ingres Server for OS/2, since the feature set will be so greatly improved in the new release.

most robust ANSI compatibility claim a vendor can make for its product is with ANSI SQL Level 2 with the Integrity Enhancement addendum.

Vendors are starting to provide enhanced versions of standard SQL that support extensions such as stored procedures, triggers, and execution control through branching and looping. Transact SQL (the dialect provided with Microsoft SQL Server and Sybase SQL Server) and PL/SQL (provided with Oracle Server) are examples of enhanced SQL dialects.

Stored procedures are precompiled SQL statements that are stored on the SQL database server. A client executes a stored procedure by issuing an `EXECUTE PROCEDURE_NAME` statement. This way, two words cross the network rather than the hundreds that could be in the procedure. And since the procedure is already optimized and compiled, the server does not need to spend additional time on these tasks. Frequently executed queries are prime candidates for stored procedures.

Triggers are similar to stored procedures and execute in response to a database event. When a trigger is associated with a SQL statement, a set of commands is executed every time the SQL statement is executed.

REFERENTIAL INTEGRITY

Relational databases are made up of separate tables that can be joined on the basis of common information. For example, a simple database for a business might contain a customer table and an order table that are linked by a customer number field contained in both tables. Since there can be more than one order per customer, the relationship between the two tables is *one-to-many*; when joined, the customer table is the *parent* and the order table is the *child*. If a parent record is deleted but the related child records are not, the child records are *orphaned*. *Referential integrity* (RI) simply means that no orphans are permitted in any table. There are three ways that a record can become orphaned: the parent record is deleted,

SQL Databases

the parent record is somehow changed so the relationship is lost, or a child record is entered without a parent record.

Databases that follow the file/server model, such as multiuser Xbase systems, depend on the programmer to include logic that ensures RI. Most SQL databases today include RI features as part of the database engine but implement them in different ways. *Declarative RI*, which is supported by NetWare SQL, IBM Extended Services, and Gupta's SQL-Base Server, is implemented through keys that are stored within the database tables themselves. Parent tables contain *primary keys* that are composed of *foreign keys* found within each of the child tables. This is the preferred method, following the ANSI Level 2 Integrity Enhancement addendum.

Another way to implement RI is through the use of triggers; this is called *procedural RI*. Triggers ensure RI by automatically executing rule-enforcing SQL statements whenever an UPDATE, DELETE, or INSERT command is encountered. For example, whenever a parent record is deleted, either all the associated child records are also deleted (*cascading deletes*) or the deletion is disallowed.

Procedural RI, which is used by SQL Server (both the Microsoft and Sybase versions), does not fully comply with the ideal of the referential model for data storage—storing all information about the tables within the tables themselves—but does give the database developer a front-end-independent method of safeguarding RI. Neither Ingres Server for OS/2 nor Oracle Server has built-in support for RI.

SQL OPTIMIZATION SCHEMES

The goal of optimization is to ensure that a SQL query returns results as quickly as possible with the fewest number of hits against the database. There are two types of SQL optimization: syntax-based optimization and the newer, more effective cost-based optimization.

Syntax-based optimization exploits the fact that in SQL, the way you specify a query can drastically alter its efficiency. With syntax-based optimization (also called rule-based optimization) a set of rules based on the physical position of expressions in the WHERE clause lets the programmer know exactly how a query will be implemented.

It takes skill on the part of the programmer to derive benefit from this knowledge. The advantage of placing the onus on the programmer rather than the database software is low overhead on the server. However, if a SQL code generator is being utilized, or if

the programmer is not experienced, there will be no gain.

With *cost-based optimization*, statistics are gathered about the database—number of tables, number of rows, types of data in each row, availability of indexing for a particular column, and so on—and the optimizer makes use of this knowledge to determine the best plan for query execution. If the optimizer determines that a full table scan would be more efficient than using an index to process a particular SQL statement, then the index would not be used no matter how the SQL statement was worded. The advantage of the cost-based method is obvious: The expertise for determining the best way to implement a query is transferred from the user to the database engine.

The disadvantage is that finding an optimal solution can take a long time. In fact, there can be so many ways to implement a query that a complete evaluation of all of them could take longer than the longest-executing solution would take. The search can be aborted by setting a time limit or—for products such as SQL Server from Microsoft and Sybase—the optimizer can be programmed to accept a “good enough” solution.

PROTECTING YOUR DATA

SQL databases have a number of built-in features to protect the integrity of your data by ensuring data consistency. *Transactions* are requests for changes to a data-

base. When a transaction is *committed*, it is written to disk from cache memory. SQL databases usually maintain a *transaction log* that records information about all changes that have been requested to the database. These transaction logs provide the ability to *roll back* committed transactions and restore the database to its previous state.

This is an important feature when a set of related transactions is only partially committed to the database because of a hardware failure. For example, when moving money between accounts, data integrity may demand that a debit in one place be balanced by a credit in another. Both transactions must be committed to the database or the data will no longer be consistent.

Many SQL databases provide roll-back capability so that if *both* transactions are not committed, *neither* will be—the partial changes will be undone. Some SQL databases, such as NetWare SQL, ensure data integrity by using transaction logs to *roll forward* and reapply transactions to an instance backup (a snapshot of the database).

Two-phase commit ensures data integrity when updates are being made in a distributed database environment. With two-phase commit, the update to the database takes place in two steps: a prepare-to-commit step, and then—if all the relevant engines respond with a “ready” signal—the actual commitment step. SQL Server and IBM Extended Services support programmer-controlled two-phase commit; no SQL database in this roundup supports automatic, server-controlled two-phase commit.

Read consistency is another important concept in multiuser database systems. Providing users with a consistent view of a database that is constantly being updated is a difficult task. The level at which a table is locked during updates—whether at the page level or the record level—can greatly influence access speed. Ideally, only the particular record being updated is locked, since that gives other users access to as much of the data as possible. When updates are being processed for many records, it's more efficient to coarsen the level of granularity and lock the entire page, rather than locking multiple records. This conserves the number of locks available to the system

Effective optimization ensures that a SQL query returns results as quickly as possible with the fewest number of database hits.



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► BENCHMARK TESTS

SQL Databases

Our benchmark tests monitored the speed of reading from and writing to the database under various scenarios. The consistency of the performance regardless of the number of workstations is typical of SQL databases.

HOW WE TESTED

To evaluate the SQL databases in this roundup, PC Magazine Labs chose a subset of tests from the AS³AP (ANSI SQL Standard Scalable and Portable) Benchmark Tests for Relational Database Systems, developed by Carolyn Turbyfill, Dina Bitton, and Cyril Orji at Cornell University. AS³AP is a cross-platform battery of benchmark tests covering a spectrum of typical database operations.

For this review, PC Labs chose to preserve the exact testing configuration used in our recent issue on file/server multiuser databases (see "Nine Multiuser Databases: Robust and Ready to Share," *PC Magazine*, March 31, 1992). While the database tables and memory configurations were arguably small for the caliber of products tested here, we provide a unique metric for direct comparison between this current crop of client/server systems and the file/server products.

We used a Compaq Systempro 486/33 as our database server, equipped with 16MB of RAM and 1.6GB (gigabytes) of hard disk storage. On the client side, we used 36 identically equipped 386SX/16-based Compaq 386/N computers. All tests were conducted on a NetWare 3.11 network running Token-Ring. Since IBM Extended Services with Database Server for OS/2 was incompatible with NetWare, IBM provided its own network drivers.

The vendors themselves provided the C code with embedded SQL statements to comply with our benchmark test specifications. Their participation was important, since it

gave each vendor the chance to optimize the code for its particular engine. Vendor representatives were on-site at PC Labs as the tests were performed to ensure proper configuration of the products. The performance achieved by these complex systems is greatly affected by the proper tuning of each product's numerous configuration parameters.



Benchmark test results are not presented for Ingres Server for OS/2 or Oracle Server for NetWare. Ingres Corp. was unwilling to commit the necessary resources to complete the benchmark test specification, or even to assist us in our own attempts to benchmark-test the product. Oracle Server's license agreement prohibits *PC Magazine* from publishing benchmark test results without Oracle Corp.'s permission. Although we tested Oracle Server with the supervision of the vendor, we are unable to present the test results because Oracle would not give its consent.

LOAD AND INDEX

The **Load and Index** test measures how quickly the system can import and index a two-table database with 100,000 rows per table. The first table contains six indexes, and the second contains three. The import files are placed on a separate NetWare file server, and the data is imported across the LAN to the database server. A clustered primary index is created for both tables.

Novell's NetWare SQL turned in the fastest Load and Index time, with its NLM-based loading facility. Since the data did not have to pass through

the workstation on its way to the database server, this feature significantly enhanced NetWare SQL's performance.

Because the Bulk Copy Program (BCP) utilities used by Microsoft and Sybase are launched from the workstation, both Microsoft SQL Server and Sybase SQL Server for NetWare were at the mercy of the processing speed of the workstation—in our case, a 386SX/16. The BCP utilities retrieve the data from the import source device and then format it at the workstation before transmitting it to the database server.

Gupta Technologies' SQLBase Server NLM turned in the slowest Load and Index time: well over 9 hours. Gupta acknowledges an implementation problem with its SPX/IPX router module that involves excessive synchronization during the bulk imports.

The Load and Index time for Sybase SQL Server for NetWare also exceeded 9 hours. The Sybase product's load times were slower than those for Microsoft SQL Server because of the added overhead of the NetLib protocol layer in the Sybase model. NetLib is an interchangeable layer that can be configured for different network platforms. Microsoft's product, tuned to the PC platform, writes directly to the network operating system's protocol.

Since IBM Extended Services does not run in a NetWare environment, the database was loaded from the database server itself rather than from another server. Its results, therefore, are not directly comparable with those of the other products.



RANDOM READ

The **Random Read** test shows the maximum number of concurrent retrievals the system can handle. In this test, each workstation randomly selects single rows from the same table and discards the results by directing the output to device NUL. Records are accessed in browse mode, permitting the greatest amount of concurrency.

We run the tests for 2 hours 10 minutes. To determine where peak throughput occurs, we increase the number of workstations gradually, adding stations at 10-minute intervals until 36 workstations are running or until the server can no longer support more connections. Throughput is calculated in transactions per second for each 10-minute interval.

Sybase SQL Server clearly

outperformed the competition on the Random Read test, thanks to its 32-bit NLM technology and the large database cache (possible because of the low memory overhead associated with each connection). Gupta's SQLBase Server, which also imposes low memory requirements on the server, placed a strong second on this test. The products from Novell, Microsoft, and IBM all reached peak performance at about 16 workstations and maintained a fairly consistent throughput rate as additional stations were added.

RANDOM WRITE

The **Random Write** test shows the maximum number of concurrent updates the system can perform. In this test, each workstation randomly

updates single rows from the same table. The value of a nonkeyed indexed field is modified so that both the selected row and the index must be updated. Rows are accessed in update mode, which permits data sharing in the table but does not allow anyone else to access a row that is currently being updated.

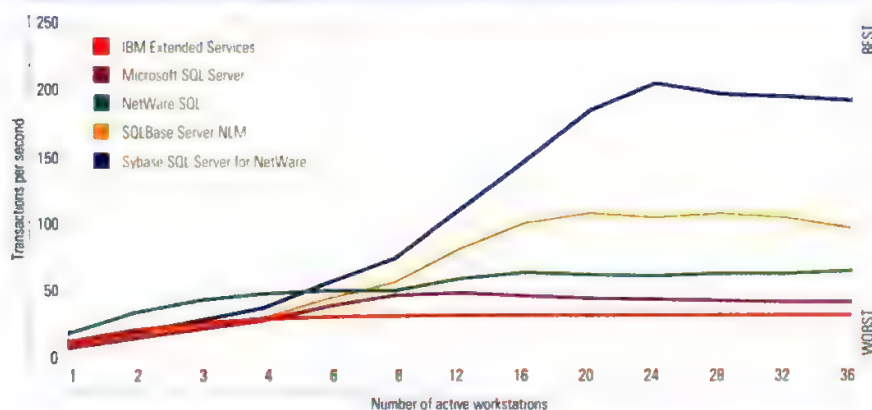
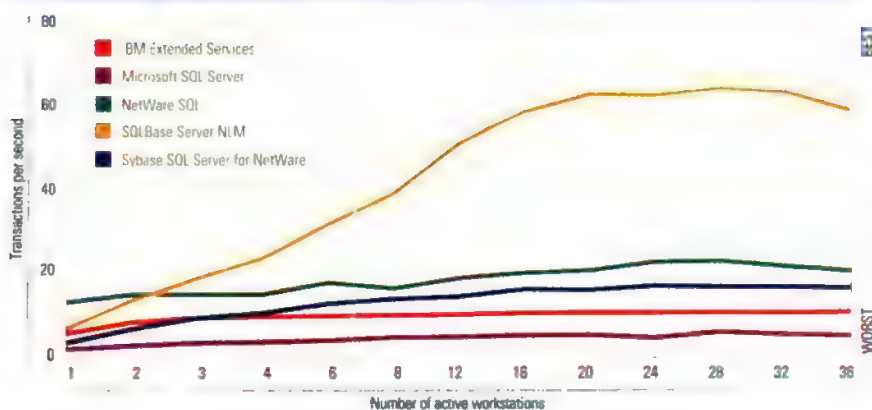
We run the tests for 2 hours 10 minutes. To determine where peak throughput occurs, we increase the number of workstations gradually, adding stations at 10-minute intervals until 36 workstations are running or until the server can no longer support more connections. Throughput is calculated in transactions per second for each 10-minute interval.

The results of the Random Write test clearly demonstrate the performance benefits of the 32-bit NLM platform and sophisticated locking mechanisms. Gupta's SQLBase Server was head and shoulders above the rest in its performance scores on this test. SQLBase Server's support of hashed clustered indexes was an important factor in its strong performance. The product also benefited from its smaller-than-normal 1K database page; the smaller page allows a higher degree of concurrency. NetWare SQL and Sybase SQL Server also turned in strong throughput scores. IBM Extended Services' results were significantly better than those of Microsoft SQL Server: this was due in large part to the IBM product's record-level locking. The smallest locking level supported by Microsoft SQL Server is a 2K page.

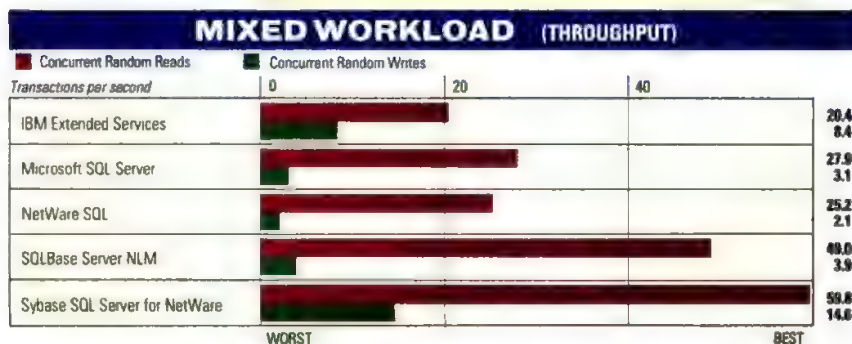
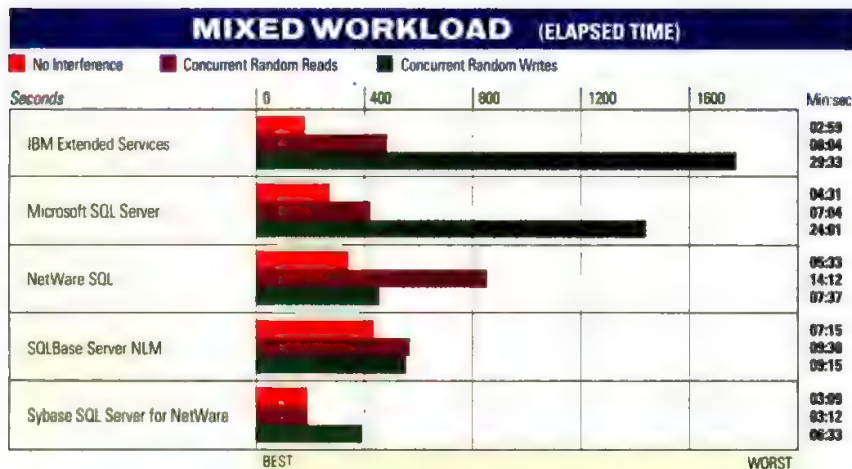
MIXED WORKLOAD

The **Mixed Workload** tests show the effect of concurrency on a cross-section of transactions executed on a single workstation. There are three Mixed Workload tests in the suite: No Interference, Concurrent Random

Continues

RANDOM READ**RANDOM WRITE**

► BENCHMARK TESTS



Reads, and Concurrent Random Writes. The results for the second and third tests are reported in terms of both elapsed times and throughput rates.

In the **No Interference** test, a single workstation runs a mixed workload of eight database operations, including queries, updates, and an aggregate report joining two tables. We record the time to run all eight operations, which can be used for comparison with the following two tests.

In the **Concurrent Random Reads** test, we run the Random Read queries on seven workstations. After allowing the seven workstations to execute for 10 minutes (to bring the database cache to a stable state), we add an eighth station running the same Mixed Workload routines as in the No Interference test. When the eighth station finishes, we stop all stations and note the total time that the eighth station took to complete its routines. To compute throughput, we divide the

total number of transactions all eight workstations performed by the total test time (ignoring the first 10 minutes used to stabilize the network).

The **Concurrent Random Writes** test is the same as the Concurrent Random Reads test, except that we run Random Write operations on the seven workstations rather than Random Read queries.

In the tests with interference, the workstations running the Random Read and Random Write tests access just one of the two tables; the Mixed Workload workstation accesses both tables.

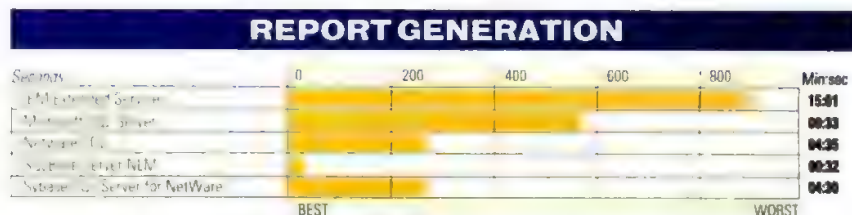
In general, the NLMs were the

performance leaders on the Mixed Workload tests. On the Concurrent Random Reads test, however, the results were less clear-cut: Sybase SQL Server turned in exceptionally good throughput and elapsed time scores, but the performance of the other NLM products (Novell's NetWare SQL and Gupta's SQLBase Server) was generally more on a par with that of the OS/2-based products. We tested two OS/2-based products for this roundup: IBM Extended Services and Microsoft SQL Server. Because of its use of record-level locking, IBM Extended Services outperformed Microsoft SQL Server in terms of throughput on both of the Random Write tests.

REPORT GENERATION

For the **Report Generation** test, one workstation prints a report while seven other workstations perform the Random Read test in the background. To produce the report, the package has to join two 100,000-row tables and generate a 1,000-row summary using date calculations, minimum and maximum values, subtotals, and totals. The results are printed to an ASCII file on the workstation that is generating the report.

The products running as NLMs performed the Report Generation test in a fraction of the time it took the OS/2-based servers. The 32-bit architecture of NetWare helped the NLMs, while the increased overhead of the Named Pipes protocol layer hindered the OS/2 entrants. Among the NLMs, Gupta's SQLBase Server turned in superior results thanks to its hashed clustered index feature.



A portrait of Napoleon Bonaparte in military uniform, holding a tablet or book, with a clock visible in the background.

MicroAge  Intel  Gateway  Palm  IBM  Compaq  HP  Dell  Acer  Sony  Fujitsu

SQL Databases

as a whole. Most SQL databases provide automatic lock escalation, which changes the level of granularity of the lock depending on the amount of data being updated (an exception is NetWare SQL).

THE SQL LANDSCAPE

The performance tests used in this review are the same as those used in "Nine Multiuser Databases: Robust and Ready to Share" (*PC Magazine*, March 31, 1992). These tests emphasize the speed of the SQL database in performing reads and updates in a variety of different environments. The vendors themselves provided the benchmark test code to implement our specification in order to ensure the code was optimized for that product. Representatives from each vendor were on-site during testing.

While the speed of a SQL database is important, its data integrity features and customer support are essential as well. In the reviews that follow, we delve into each of these issues to help you decide which SQL database best meets your needs.

IBM Corp.

IBM Extended Services with Database Server for OS/2

BY JONATHAN ZUCK

IBM Extended Services with Database Server for OS/2 may not have all the advanced features of its competitors, but it does boast declarative referential integrity and the ability to store compiled code on the server. And for the low price of \$1,995, you also get IBM's Communication Manager for connecting the server to a client system, a product most other vendors sell separately. If you purchase Distributed Database Connection Services/2 (\$4,680), you can have transparent connectivity to DB2 databases on larger computers. These features and its solid performance make IBM Extended Services a strong choice for budget-minded firms or for IBM shops that need to connect to existing mainframe databases.



IBM had hoped to make the first release of Extended Services a 32-bit OS/2 2.0 application, but it is still a 16-bit application based on the OS/2 1.x API; the 32-bit version is in the works. Unlike its predecessor, which bundled the OS/2 operating system with the package, Extended Services does not include OS/2.

EXTENDING THE TECHNOLOGY

Installing Extended Services is unusually easy: You specify what sort of client connectivity you want to support (DOS, Windows, or OS/2) and the necessary directories are built for you on the server. The OS/2 client installation process is virtually identical to the server installation process; the only difference is in the options you select. For DOS or Windows clients, you simply copy the necessary files from the server to the workstation.

One of the key strengths of IBM's SQL database is its Database Application Remote Interface (DARI), which lets programmers move large portions of client applications to the server in the form of DLLs (dynamic link libraries). IBM refers to these DLLs as "stored procedures," but it is important not to confuse them with the remote SQL procedures available with the SQL database products from Microsoft, Sybase, Novell, and Ingres. The DARI DLLs are compiled program code written in C, FORTRAN, COBOL, or REXX. The functions contained within remote DLLs can be seamlessly accessed by clients at run-time. Data integrity is maintained by the engine, since these functions are called as subroutines of the main program.

Use of remote procedures in DLLs enhances performance speed. This is most obvious when executing multistep queries, but even with a single SQL statement there are gains. Ordinarily it takes two round-trips across the network cable to execute a query and retrieve the results; with DARI, only one function call is required. Besides leaving more network resources for other processes, DARI can extend the functionality of IBM Extended Services (for example, by adding data-translation capability).

DB2 COMPATIBILITY

It's no surprise that the company that makes DB2 would endeavor to provide a PC-based client-server engine that is

compatible with DB2. Accordingly, the SQL syntax and declarative integrity features of IBM Extended Services closely match those of DB2. IBM's only real competitor in this arena is XDB Systems, whose SQL database product actually surpasses IBM in DB2 API compliance.

IBM's strict adherence to the DB2 standard, ironically, has had the undesirable effect of holding IBM back when it comes to innovation, because the DB2 standard evolves very slowly. For example, there is no support for live, on-line database backup and no support for triggers. Since a primary use of triggers is to enforce referential integrity (RI), IBM's support of the preferred declarative RI mitigates the need for triggers to some extent. But triggers are also useful for enforcing business rules that are unrelated to relational integrity. For this reason, if you have many inexperienced users accessing your company's data, IBM's Extended Services may not be a good choice.

FACT FILE

IBM Extended Services with Database Server for OS/2, Version 1.0

IBM Corp., Old Orchard Rd., Armonk, NY 10504; 800-426-2255, 914-765-1900; fax: 303-440-1639

List Price: 16 users (comprehensive package), \$3,195 (with Distributed Database Connection Services/2, \$7,875); 1 user, \$595; unlimited users, \$1,995 plus \$75 per client (enabled for DOS, Windows, and OS/2). Distributed Database Connection Services/2 (for networks), \$4,680; single-user package, \$500.

Requires: 6.6MB RAM plus 0.2MB RAM for each client, 28MB to 43MB hard disk space (for OS/2 2.0; less for OS/2 1.3), OS/2 1.3 or later. LAN support: LAN Server 2.0. Protocol support: APPC, APPN, NetBIOS (DOS and OS/2 clients).

In Short: IBM Extended Services lacks some of the more advanced features found in other products, but it has full support for declarative referential integrity and the unique ability to store compiled code on the server as a DLL, where it can be accessed through function calls. Its ability (with an optional purchase) to connect to DB2 databases transparently will make it attractive to IBM shops with an interest in accessing existing databases on mainframes.



ON READER SERVICE CARD

If you're looking
for a notebook
computer that's
easy to use,
there are basically
only two ways
you can go.

The hard way.



Extra memory, \$210. Most notebook computers in use today simply aren't fast enough to make Windows 3.1 practical. And many that are fast enough may require extra memory, which can add hundreds of dollars to their price tag.



Clip-on trackball, \$172. If you're going to try to use Windows 3.1 on many portable computers, you may have to plug this in and clip it onto the side of your computer. (Be careful not to catch the cord in your airplane tray.)



New programs, \$506 each. Unless you buy programs specifically designed for Windows 3.1, you'll have to use conventional character-based programs and their awkward commands.

Fax/data modem, \$142.

The ability to communicate on the road is what makes a notebook PC really valuable. So you'll have to pack one of these. Once you get back to the office, be prepared to shell out another \$138 to update the files on your desktop PC, and over \$500 just to access network file servers and printers.



The coach seat factor. If you want to run Windows 3.1 on most portable computers, you'll find that you need a front-mounted keyboard and a side-mounted trackball or mouse. What you won't find is enough room on an airplane tray to hold it all.

Ordinary notebook, \$2,497. The typical notebook computer of today was designed to run DOS only, not Windows 3.1. It doesn't have enough memory, speed or screen brightness, and its screen isn't fast enough for high-quality graphical computing.

Comfort is something most notebook computer ads never talk about. Because, truth is, they're not very comfortable to use. Which may explain why they don't win awards for being well designed. (PowerBook, of course, has won more design awards than all other notebook computers combined.)



Added weight. Many notebook computers may claim to weigh less than 7 pounds, but by the time you add all the components you need to make Windows 3.1 work well, you're likely to find yourself with an additional 4 or 5 pounds to lug around.



Your time, name your price. Fiddling around with MS-DOS or Windows 3.1 on the road can cost you plenty of time. How much is yours worth?



Instruction manual, 2 pounds. There's nothing like forgetting a DOS command when you're 2,000 miles from home, so you may want to carry a manual with you. And since Windows 3.1 is based on DOS, you'll definitely want instructions handy.



The Apple® Macintosh® PowerBook™ is the only personal computer to make the Products of the Year lists of *Business Week*, *Fortune*® and *InfoWorld*. And the only notebook computer to be named one of the Best Designed Products of the Year by *Time*®. Because it's the only computer designed as

The easy way.

Consistent applications. Every PowerBook runs thousands of Macintosh programs (including Lotus 1-2-3 and WordPerfect) that all work in the same consistent, intuitive way. You learn one, you know the basics of all of them.

Blistering speed. Because Macintosh computers are optimized for graphical computing, PowerBook can significantly outperform comparably priced notebook computers running Windows.™ Both the PowerBook 170 and the new PowerBook 145 deliver an impressive combination of speed and power at an affordable price.

Built-in Balloon Help. Point at what you want to know about, and your Macintosh will tell you what it's for. So you can leave your manual in a desk drawer at home.

Built-in networking. Plug your PowerBook into an AppleTalk® network, and conveniently access all network resources—printers, file servers, e-mail, even other networks from Novell, IBM and Digital.

AppleTalk Remote Access. This remarkable software comes with every Macintosh PowerBook. It not only allows you to access all the files on a modem-equipped Macintosh at your office or at home, it also gives you complete access to your network—printers, files, file servers, e-mail—from anywhere there's a phone.

Built-in fax/data modem. With this option, you can send your work directly to a fax machine or access e-mail from almost any telephone anywhere you happen to be. Just plug the phone cord into the back of the PowerBook.

Built-in file sharing. On most notebook computers, sharing information with a desktop computer is virtually impossible. But every PowerBook has powerful file sharing built in. So you can easily connect your PowerBook to a desktop Mac® or another PowerBook and copy files from one computer to the other.

Built-in peripheral support. Like every Macintosh, PowerBook lets you add up to six external hard drives, CD-ROM drives, scanners or other peripherals simply by plugging them in.

Palm rests. Working on the road isn't like working at your desk. So Apple designers provided a place to rest your hands, making it much easier and more comfortable to work in tight quarters—such as a middle seat on an airplane.

Integrated trackball. Everything about Macintosh computers is designed to make it easy for you to work. In the case of PowerBook, the pointing device is integrated into the computer. There's nothing to hook up or clip on. Open it up and you're ready to go. (It's comfortable whether you're left- or right-handed, too.)

It's compatible. Like every Macintosh, PowerBook is compatible with the personal computers you use at the office. It can read from and write to floppy disks from MS-DOS or OS/2 PCs, or even run DOS software using programs such as SoftPC.



a totally integrated system. Combining hardware, software and industrial design to make working on the road as comfortable as working at your desk. It's more intelligent. It's more convenient. It's power anyone can use, anywhere you happen to be. The power to be your best.



How to connect to a network file server.

The hard way:

1. Purchase an external network adapter.
2. Install the network adapter.
3. Connect the network cable.
4. Plug in AC power supply if needed.
5. Install network software and configure parameters.
6. Start Windows.
7. Run Windows Setup to load network software.
8. Restart.
9. Start Windows.
10. Start File Manager.
11. Select the desired file server.

The easy way:

1. Connect the network cable.
2. Open Chooser.
3. Select AppleTalk "Active" button.
4. Select desired file server.

How to retrieve a deleted file.

The hard way:

1. Purchase a utility program.
2. Install it on your computer.
3. Restart the computer.
4. Start Windows.
5. Start the utility program.
6. Start the unerase feature.
7. Find the directory where your file existed.
8. Click on that directory.
9. Select the deleted file.
10. Choose unerase command.

The easy way:

1. Double-click on the trash can.
2. Drag the deleted file out of the trash can.

How to rename a directory.

The hard way:

1. Double-click on the Main group in Program Manager.
2. Start File Manager.
3. Highlight the directory you want to rename.
4. Select "Rename" from the file menu.
5. Type in a new name for the directory (must be 8 characters or less).
6. Go to Program Manager if needed.
7. For each application in the renamed directory, select "Properties" from the file menu.
8. For each application in that directory, change the command line to reflect the new path to the application program.

The easy way:

1. Highlight the directory (folder) you want to rename.
2. Type a new name (up to 31 characters).

How to add an external hard disk drive.

The hard way:

1. Purchase a parallel-to-SCSI adapter.
2. Connect it to the parallel port.
3. Plug the drive into the adapter.
4. Insert the adapter's installation disk in drive A:.
5. Select drive A:.
6. Type "INSTALL".
7. Select appropriate options for your drive.
8. Select appropriate drive for software installation.
9. Restart.
10. Run installation test program.

The easy way:

1. Plug the drive into the SCSI port.
2. Start up the PowerBook.

How to play a sound.

The hard way:

1. Purchase a sound upgrade kit.
2. Attach sound upgrade hardware.
3. Install sound upgrade's software drivers.
4. Start the sound recorder program.
5. Select Open from the file menu.
6. Select the sound file you want to play.
7. Choose OK.
8. Click on the Play button.

The easy way:

1. Double-click on the sound's icon.

How to add a pointing device.

The hard way:

1. Purchase a pointing device (such as a mouse or trackball).
2. Open notebook's back panel.
3. Attach appropriate port adapter to pointing device (if other than 9-pin).
4. Connect pointing device to proper port.
5. Choose appropriate clamp arms.
6. Attach pointing device to clamp arms and adjust tilt angle.
7. Start the computer.
8. Install driver software.
9. Restart.

The easy way:

1. The trackball is built in.

Macintosh. The more you do, the easier it gets.

For an authorized Apple reseller, call 800.538.5696, ext. 160. This price and all the prices noted here reflect average Manufacturer's Suggested Retail Prices. **Comparisons are based on a 1991 independent research study, conducted by Inspec Laboratories that tested a variety of personal computers running applications available for both the Macintosh and Microsoft Windows 3.0 environments. ©1992 Apple Computer, Inc. All rights reserved. Apple, the Apple logo, AppleLink, Mac, Macintosh and "The power to be your best" are registered trademarks of Apple Computer, Inc. Balloon Help and PowerBook are trademarks of Apple Computer, Inc. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. MS-DOS is a registered trademark and Windows is a trademark of Microsoft Corporation. iN2 is a registered trademark of International Business Machines Corporation. SoftPC is a registered trademark of Inspec Solutions Inc. WordPerfect is a registered trademark of WordPerfect Corporation. L&L™/LLA

On the other hand, Extended Services' implementation of declarative RI demonstrates that compliance with the DB2 standard doesn't always imply lagging technology. Extended Services also boasts record-level locking and the same high-quality cost-based optimizer found with DB2; both are examples of how compliance with the DB2 standard has led to a better product.

WEAK TOOLS, SOLID PERFORMANCE

While the API exists to build client-side tools for database administration and backup, IBM has opted not to do so. Database administrators must be connected to the server to add or delete users, set privileges, or perform other administrative functions. Only four of the five administration tools provided by IBM are graphical, but the interface is CUA-compliant throughout.

Since IBM Extended Services cannot coexist with NetWare, our test-bed was altered slightly so we could test the product. IBM supplied its own custom network drivers to allow the workstations to

SUITABILITY TO TASK				
IBM Extended Services with Database Server for OS/2				
Mission-critical tasks	●	●	●	●
SQL programming	●	●	●	○
Connectivity and portability	●	●	●	○
Data storage	●	●	●	○
Transaction processing	●	●	●	○

communicate with the server in our hardware configuration. We caught a glimpse of the "new IBM" prior to our testing period when, upon receiving our testing specifications, IBM leapt over many technical (and no doubt bureaucratic) hurdles to produce drivers that would work with the Proteon 1990 network boards we were using—a previously unsupported network interface card for IBM.

IBM Extended Services' performance on our tests was virtually unaffected as we added workstations; the graph of its performance on each test was almost a straight line. Except for a slow mark on the Complex Report test, the product's

results were middle-of-the-road.

While it may not have the advanced features that other products have, Extended Services is a solid product that IBM is more than willing to go out of its way to support. If you don't want to spend a lot of money on a SQL database, or if your company is an IBM shop with existing DB2 databases, IBM Extended Services may be a good choice for you.

Ingres Corp.

Ingres Server for OS/2

BY JOE SALEMI

Ingres is best known as a vendor of technically excellent, Unix-based SQL databases. Ingres Server's groundbreaking cost-optimization technology has been adopted throughout the industry, and its domain-integrity features are the most complete of any SQL database. But the most recent version of Ingres Server, Version 6.4, is not yet available on the OS/2 platform. (There is no NetWare version at this time.) Ingres Server for

■ Unix Means Scalability and 32-Bit Performance

by Sheryl Canter

There has been much talk about OS/2 2.0 being the first 32-bit operating system for the PC platform, but it's not actually first. Unix is a 32-bit operating system that's been available on PCs for nearly a decade. Highly scalable, there is a version of Unix available for almost any processor you can imagine, from a desktop computer to a room-filling mainframe. In addition to maturity and scalability, Unix also boasts the unique advantages of multiple-user and multiple-processor support.

The ubiquitousness of Unix on computers of all sizes makes the move to a bigger box relatively painless, since virtually all the same tools and procedures can be retained. Just about every major SQL database vendor, including Gupta Technologies, Informix, Ingres, Oracle, and Sybase, has a version of its product that runs on Unix. In many cases, Unix was the SQL database's first platform; versions for NetWare and OS/2 were later additions. In fact,

vendors often update the Unix versions of their products before other versions, with the result that the Unix product supports a more advanced feature set.

Multiple-processor support is another key advantage offered by many versions of Unix. For a well-tuned SQL database, the processing power of the server is often the last remaining constraint. On OS/2 and NetWare systems, you can add more disk drives and more RAM, but you can't add more CPU power; Unix doesn't suffer from this limitation. Some Unix boxes (such as Sequent) can support as many as 30 processors. Microsoft's NT operating system, due to be released in 1993, will also support multiple processors and multiple platforms. But until NT hits the market, Unix is the only PC operating system with these capabilities.

Like OS/2, Unix is a preemptive, multitasking operating system. (NetWare is not preemptive; the NLMs themselves are responsible for relinquishing system resources so

other applications can have access.) But unlike either OS/2 or NetWare, Unix is also a multiuser operating system. With Unix, you can store both the "back end" and the "front end" on the same machine, and access both via a dumb terminal. This can be a very efficient configuration when a user must connect remotely and the client application is passing a lot of data back and forth to the server. When multiple processors are used on the server, the increased load can be handled easily.

While there are advantages to Unix, they come at a price. Unix hardware and software are usually more expensive than systems destined for either OS/2 or NetWare. Because of the complexity of Unix and the arcane (by today's standards) administrative facilities, the same can be said for the administrative and training resources necessary to run a Unix system at peak performance. But if you need a state-of-the-art SQL database system, you ought to take a look at Unix. □

SQL Databases

OS/2 6.2 shares the solid code base of the Unix version, but many advanced features are not implemented, and its value is diminished by poor documentation and weak technical support. We even had difficulty verifying the feature set, since different technical contacts at Ingres gave us different (and occasionally contradictory) answers to our questions.



NOT QUITE SOUP YET

To ensure that the benchmark test programs were optimized for each vendor, we asked the vendors themselves to write the programs to comply with our benchmark test specification. Unfortunately, we were unable to test Ingres Server, because Ingres could not spare the in-house resources at the time of our evaluation to create the test programs.

We went ahead and installed Ingres Server anyway. Installing the server software and establishing the connection to the client system proved difficult because of the disorganized and poorly written documentation. It took repeated calls to technical support to get the system up and running. Another source of confusion with Ingres Server for OS/2 is its retention of Unix naming conventions such as command line case sensitivity, which is highly nonstandard on the OS/2 platform.

HIGH ON TECHNOLOGY

Despite the lack of benchmark test performance results, here's what we can tell you about Ingres Server from a technological standpoint. Ingres pioneered cost-based optimization, a method whereby the engine reviews the various means of resolving a query and statistically estimates which method will be most efficient. Cost-based optimization has been adopted throughout the industry. The Ingres optimizer has the ability to flatten a SQL query into a syntax-independent relational algebra that ensures that no matter how the query is worded, the optimizer will deliver the same result. The quality of the optimization results does not depend on the particular syntax the programmer chooses.

As the number of elements in a query

increases, the number of ways to implement it increase geometrically—and the search for the fastest solution can take longer than executing the unoptimized query itself would have! Some industry observers have said that Ingres Server falls into the trap of continuing to search for the fastest solution when a "fast-enough" solution would have taken less time overall because of the optimizing time saved. Unfortunately, we could not verify this claim because, as explained, Ingres would not participate in our benchmark tests.

Ingres Server has the most complete and robust domain-integrity features of any SQL database. Not only can you define new data types to match the most specific requirements, but a naming feature lets you build a domain hierarchy that prevents nonsensical joins between tables. For instance, you can prevent an erroneous join between a customer ID number in one table and a part number in another table, even though the numbers happen to be identical.

Ingres Server supports stored procedures, which can be created through statements in a client application or interactively from the workstation. But unlike SQL Server from Microsoft and Sybase, Ingres Server's stored procedures can't be accessed interactively; they can only be called from embedded SQL statements in a client application. This limitation will be removed in Version 6.4, which should be released by the end of this year.

The current version of Ingres Server for OS/2 does not support triggers (or "rules" in Ingres terminology), although Ingres says they will be supported in Version 6.4. Since triggers are not supported, there is no way to implement procedural referential integrity (RI). Nor is there support for declarative RI in the current version. There is no server-side enforcement of RI at all; it is left in the hands of the front-end application programmer.

Striping is an interleaving technique for distributing the I/O burden across multiple disk drives. Ingres Server supports striping of the database across multiple hard disks, but the transaction log must be contained on a single drive. The present version counts on OS/2 to provide data-protection features such as disk mirroring, and live on-line backup is not

SUITABILITY TO TASK

Ingres Server for OS/2

	POOR	FAIR	GOOD	EXCELLENT
Mission-critical tasks	●	●	○	○
SQL programming	●	●	●	●
Connectivity and portability	●	●	○	○
Data storage	●	●	●	○
Transaction processing	●	●	●	○

supported, although Ingres Corp. says it's planned for Version 6.4.

STEEP HARDWARE REQUIREMENTS

Ingres Server is unique in that it requires high-end hardware on the DOS client. The Ingres/NET communications package (which costs an additional \$200 per workstation) requires a 286 processor or better, 2MB of extended memory, and 6.3MB of hard disk space, and must be run on both the client and the server. Its hefty hardware requirements are necessitated by its comprehensive functionality, including a bridge to a wide array of different platforms, but it's an all-or-nothing

FACT FILE

Ingres Server for OS/2,
Version 6.2

Ingres Corp., 1080 Marina Village Pkwy.,
P.O. Box 4026, Alameda, CA 94501-1095;
510-769-1400

List Price: 16 users (comprehensive package), \$2,494; \$1,995 per server. API communications package (required): \$599.

Requires: 5MB RAM (8MB recommended), 10MB hard disk space, OS/2 1.1 or later for LAN Manager or LAN Server networks. Client requires: (for character-based systems) 286-based PC or better, 3MB RAM, 6MB swap file; (for GUI-based systems) 386-based PC or better, 6MB RAM, 6MB hard disk space. LAN support: IBM LAN Server, Microsoft LAN Manager, NetWare. Protocol support: NetBIOS, SPX/IPX, TCP/IP.

In Short: Although the Unix version of Ingres Server is technologically excellent, the OS/2 port is not quite ready for prime time. The documentation is weak, and the feature set of Version 6.2 lags behind its Unix sibling. Version 6.4 of Ingres Server for OS/2, due to be released by the end of this year, will bring the OS/2 version feature set up to speed; we recommend waiting.



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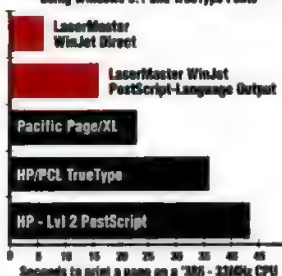
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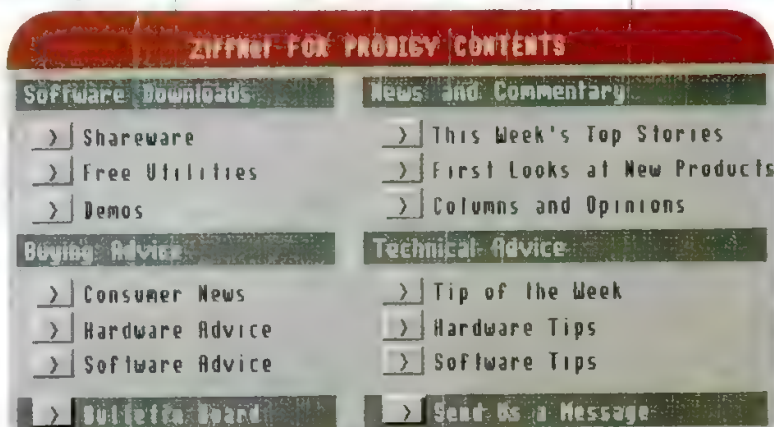
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SQL Databases

Microsoft Corp.

Microsoft SQL Server

BY JOE SALEMI

Technology makes for strange bedfellows, and one of the strangest is the SQL-world union of Microsoft and Sybase. Microsoft SQL Server is an OS/2 port of Sybase SQL Server, which runs on Unix and other platforms; Microsoft licenses code from Sybase and then optimizes it for OS/2. Version 4.2 of Microsoft SQL Server, released this past March, is an upgrade from Version 1.11; it now includes the full feature set of the widely respected Sybase product, which also carries the designation Version 4.2.

In an interesting twist, Sybase recently released a NetWare version of its server (which is also reviewed in this issue), and Microsoft is preparing a Windows NT version for release in early 1993. Although Microsoft SQL Server can be run on OS/2 2.0, it is still based on the 16-bit OS/2 1.x API (application programming interface) and does not take full advantage of OS/2 2.0's 32-bit features. One of the big unknowns is whether Microsoft (or Sybase) will continue to upgrade the OS/2 version; Microsoft representatives say that the NT version will be its first 32-bit release.



CALLING ALL FORMATS!

Microsoft SQL Server, Version 4.2, includes Open Data Services (ODS), an architecture that allows data from Microsoft SQL Server to be seamlessly integrated with other data sources. ODS applications (the API is compatible with the Sybase Open Server API) sit between the client system and the engine, fielding requests from clients. Five main types of events are handled: connect, language (such as a SQL statement), stored procedure call, disconnect, and attention (cancellation of a pending request). Programmers can use ODS to write gateways into other databases, enhance network security, audit server access, or notify clients of real-time events. The possibilities are limited only by the programmer's skill.

Fault tolerance—the ability to transparently recover from system errors—has traditionally been the domain of larger computers. Version 4.2's mirroring capabilities brings fault tolerance to PC-based systems. With *mirroring*, a duplicate of the database and transaction log is stored on a separate device. So if a hard disk crash occurs, the mirror image can take over—in many cases without any downtime. While most networks offer some sort of disk mirroring, SQL Server's is highly granular and is able to mirror just the database or just the transaction log. Mirroring slows write performance, but it can be turned off without bringing down the database.

Microsoft SQL Server's enhanced device handling works with the added security offered by mirroring; the maximum number of database devices per server has been expanded to 256. Each logical device uses a separate thread, providing asynchronous I/O capability even within one physical device. As before, the transaction log can be stored on a different device from the database, and a database or transaction log can span multiple disks. That allows for larger databases and improved performance because of the additional read/write heads.

Another improvement in Version 4.2 is Dynamic Online Backup to tape. With it, you need not bring down the database for the several hours it can take to complete a backup; backups can be run while users are accessing SQL Server. When an update request is received, the order in which data is backed up is adjusted so that the portion to be updated is backed up as soon as possible. This is necessary, since updates to the database are not executed until the relevant portion has been backed up. Because of this, live backups entail a performance hit and should not be scheduled during peak hours.

SQL Server has always provided support for stored procedures and triggers, two enhancements that will be part of the next ANSI SQL specification. *Stored procedures* are named routines stored in compiled form on the database server

that improve performance by reducing network traffic; the front-end need send only the procedure name, rather than the entire procedure, down the cable. Another advantage is that a shared procedure with changing business rules (such as a late-payment penalty scale) can be

maintained in only one place: the server.

Triggers automatically execute one or more SQL commands whenever an INSERT, UPDATE, or DELETE command is executed. For ex-

ample, a trigger associated with an inventory update might call a set of SQL statements that generate a message if inventory falls below a predetermined point. The most important use of triggers, however, is to ensure referential integrity. *Referential integrity* (RI) mandates that when a record is updated or deleted in one table, it is changed in all tables; otherwise, the action is disallowed. RI implemented through triggers (*procedural RI*) is not the preferred method, because the relationships between tables are not stored within the tables themselves.

With Version 4.2, a stored procedure can call and execute procedures stored on a remote server and return the results to the client. A step toward distributed processing, this lets you call a stored procedure to retrieve data from multiple servers without having to know where each part of the data is physically stored.

Remote stored procedure calls are particularly powerful when used in conjunction with ODS. Say, for example, you want an electronic mail message to be sent to the president of your company every time a salesperson makes a large sale. A trigger could be set up on the sales table to detect INSERTs for sales of \$100,000 or more. This trigger would call a remote stored procedure on an ODS server, which would in turn send an electronic mail message to the president, giving him or her the good news. It is important to point out that while this capability is powerful, it would not be trivial to implement. But then again, who ever said client/server solutions were easy?

SUITABILITY TO TASK

Microsoft SQL Server

	POOR	FAIR	GOOD	EXCELLENT
Mission-critical tasks	●	●	●	●
SQL programming	●	●	●	●
Connectivity and portability	●	●	●	○
Data storage	●	●	●	●
Transaction processing	●	●	●	●

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SQL Databases

Version 4.2 also lets you nest triggers. If a trigger on Table A updates Table B and Table B also has a trigger, the trigger on Table B would be executed. Prior to Version 4.2, the update on Table B would be executed, but the trigger on Table B would be ignored. Triggers can be nested for a total of 16 calls. The limitation on the number of nested triggers prevents endless loops due to circular calls.

MODEST REQUIREMENTS, EASY TO USE

Microsoft SQL Server's communications TSR uses only a modest 11K to 13K of RAM (compared with over 200K for Gupta Technologies' SQLBase Server). When running on a NetWare LAN, Novell's Named Pipes program for inter-process communication is also required, bringing the total to 45K. But by the time you read this, Microsoft will have an upgrade in beta that lets the product address SPX/IPX directly. Microsoft SQL Server can also be run with Microsoft LAN

Manager, LAN Server, and VINES.

Microsoft's SQL Server is the slowest or close to the slowest on all of our benchmark tests. A central reason is that it is a 16-bit OS/2-hosted system. Its poor Load and Index performance, however, can also be explained by its workstation-based bulk loading facility, which doesn't take advantage of the power of the server.

Microsoft SQL Server comes with both character- and Windows-based System Administration utilities that let you create and remove tables and users, run ad hoc SQL queries, and monitor system performance. The Windows version lets you monitor performance in real time, which provides a constantly updated display rather than just a snapshot. While all SQL databases provide security at the user level, SQL Server is among the few with the convenient ability to set protection by user group.

An important consideration in the choice of a back-end is the range of front-end tools available to access the back-end. SQL Server is the most widely supported of the PC-based database servers, with the largest number of third-party front-ends available. Microsoft has programmer's toolkits available for creating SQL front-ends in C, Visual Basic, and COBOL.

Although it wasn't the fastest performer on our benchmark tests, Microsoft SQL Server leads the pack with its widespread front-end support, ease of administration, and data access features. All things considered, Microsoft SQL Server is an excellent choice.

Novell Inc.

NetWare SQL

BY JONATHAN ZUCK

NetWare SQL, from Novell, is different from the other products in this review in that it's built on a popular record-oriented database management system: Btrieve. NetWare SQL gives SQL ad hoc query support to currently existing Btrieve applications.

One of NetWare SQL's strengths is that it provides a smooth migration path for existing Btrieve databases from record-level access to relational access. But NetWare SQL has many other strengths,

as well. NetWare SQL provides declarative referential integrity (RI), true backward scrolling, and location transparency, which lets users join tables on different devices. And since it is a true 32-bit NLM, it's fast, too. Despite Novell's light-handed marketing of the product, NetWare SQL has the second-largest installed base in the NetWare world, behind Oracle. A reputation for superb customer support and the huge installed base of Btrieve users are key reasons for NetWare SQL's success.

While NetWare SQL's use of the Btrieve engine is viewed as a benefit by those converting Btrieve databases to the relational model, some people have criticized previous versions of NetWare SQL because applications other than NetWare SQL could access Btrieve data and violate RI. Novell has addressed this problem in Version 3.0 by implementing new data integrity features in the Btrieve engine itself; Btrieve, Version 6.0, is bundled with NetWare SQL 3.0. Violations of RI can now be prevented, no matter what application attempts to access Btrieve data.



AT HOME ON NETWARE

NetWare SQL's implementation as an NLM greatly enhances its performance, since (as discussed in the introduction to this story) NLMs essentially become part of the operating system. Because the primary product of Novell is NetWare, Novell has encouraged other vendors to share this advantage by producing NLM versions of its products.

Novell's NetWare SQL has some unique advantages over other NLMs, though—advantages that come from the integration of the various caches operating on the server. There is a cache provided by NetWare for all file operations, a cache provided by Btrieve for its operations, and a cache provided by NetWare SQL. Normally this would represent a strong potential for conflict, but since each of these products is produced by Novell (NetWare SQL is the only SQL NLM to use the NetWare file system), the caches are able to cooperate with each other at a low level of operation.

FACT FILE

Microsoft SQL Server,
Version 4.2

Microsoft Corp., System Software Sales, One Microsoft Way, Redmond, WA 98052; 800-227-4679, 206-882-8080; fax, 206-936-7329

List Price: 16 users (comprehensive package), \$7,995; 10 users, \$2,995; unlimited users, \$7,995; developer's system (single user), \$1,495. Microsoft SQL Server Programmer's Toolkit for C, COBOL, or Visual Basic, \$495.

Requires: 8MB RAM, 20MB to 30MB of hard disk space, OS/2 1.21 or later (OS/2 1.3 is included in the package). Client requires: 50K RAM; DOS 3.x or later, OS/2 1.21 or later, or Windows 3.x. LAN support: Banyan VINES, IBM LAN Server, Microsoft LAN Manager, NetWare, 3COM 3+Open. Protocol support: Named Pipes, SPX/IPX, TCP/IP.

In Short: Version 4.2 offers increased server-based processing capabilities, enhanced data integrity features, and a bundled architecture (Open Data Services) for communications beyond the database system. While boasting the same feature set as Sybase SQL Server for NetWare, platform makes a significant difference. Microsoft SQL Server's speed and price are both much lower than those of its Sybase sibling. With its broad third-party front-end vendor support, Microsoft SQL Server is a strong choice for those who want state-of-the-art technology but find NLMs too risky.



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CIRCLE 142 ON READER SERVICE CARD

SQL Databases

Other vendors don't take advantage of the NetWare file system, and the reason is simple: NetWare SQL runs only on the Novell platform. Vendors who support versions of their SQL database across multiple platforms prefer to use the direct file system and write their own caching algorithms so they can maintain a single code base across platforms.

Although NetWare SQL can run only on a NetWare server, it is less limited on the client side.

NetWare SQL has long been accessible from DOS, OS/2, and Windows; it is now accessible from the Macintosh via Apple's Data Access Language (DAL) for network communications. With Version 3.0 of NetWare SQL, DAL-compliant Mac applications such as ClearAccess, Excel, 4th Dimension, and HyperCard are able to access NetWare SQL databases.

The NetWare SQL Developer's Kit, available for \$795, provides APIs for development using C, Pascal, BASIC, and COBOL. SQL database development is often done using a standalone version of the engine. There is no standalone engine for this version of NetWare SQL—nor has one been announced—although one was available for previous versions.

DATA ACCESS FEATURES

NetWare SQL provides a number of advanced features. It has the ability to perform live, on-line backups with a minimal performance hit by storing the updated portions of the database in memory until they have been written to tape. As long as a transaction log is utilized, updates will not be lost in the event of a power outage. This contrasts with the SQL Server solution, which prevents updates until the relevant portions of the table have been backed up.

Referential integrity is another strength of Novell's NetWare SQL. Some SQL databases (such as Oracle Server and Ingres Server for OS/2) rely on the programmer to ensure RI. Others (such as SQL Server) implement procedural RI through the use of triggers. This is a better solution than relying on client applica-

tions, but is still not optimal because the relationships between tables are not stored within the tables themselves. NetWare SQL (along with Gupta's SQLBase and IBM Extended Services) supports declarative RI, implemented through primary and foreign keys stored along with the tables.

NetWare SQL, like Gupta's SQLBase, implements true backward scrolling on the server. The only other

SQL database to provide anything like this capability is SQL Server (both the Microsoft and Sybase versions), but SQL Server supports only a client-side work-around. NetWare SQL also lets you

join tables on different devices with ease, a feature termed *location transparency*. The only other SQL database to provide this feature is the Oracle product.

An important improvement with Version 3.0 is page locking, rather than the previously supported table locking. While this enhanced granularity provides a significant performance boost over previous versions, NetWare SQL still does not support the finest level of granularity—record-level locking—which is provided by Oracle Server and others. Nor does NetWare SQL provide automatic lock-level escalation for conserving the number of locks used when accessing large amounts of data.

NetWare SQL held its own on our tests, outshining the OS/2-based products and demonstrating some distinctive performance advantages. With its server-based loading facility, NetWare SQL was the fastest at loading and indexing our test database. Its results on our Random Write test were also excellent, demonstrating the advantages of the NetWare SQL's integration with Novell's network operating system, and the product's page-level locking architecture.

WHAT'S MISSING

Because its SQL syntax is based on the IBM mainframe DB2 standard, NetWare SQL lacks some of the language extensions found in the current crop of PC products. NetWare SQL supports param-

eter-driven compiled SQL statements stored on the server but, as with Gupta's SQLBase Server, the statements can only be executed sequentially. You cannot specify branching or looping logic as you can in the stored procedures implemented by SQL Server and Ingres Server.

Other important features are missing as well. NetWare SQL 3.0 does not support cost-based optimization, triggers, or two-phase commit. Nor is there any scalability beyond the LAN via either gateways or multiplatform engine support. Some of these shortcomings will soon be rectified; NetWare for Sequent has already been announced, as have versions for other platforms.

Despite its limitations, NetWare SQL is a strong performer and offers some unique advantages (like Btrieve access) over other products in this category. Customer support is critical when choosing a SQL database, and Novell's reputation in this area is another point in its favor. All this makes NetWare SQL a strong contender.

SUITABILITY TO TASK

NetWare SQL

	POOR	FAIR	GOOD	EXCELLENT
Mission-critical tasks	●	●	●	○
SQL programming	●	●	●	○
Connectivity and portability	●	●	○	○
Data storage	●	●	●	○
Transaction processing	●	●	●	○

FACT FILE

NetWare SQL, Version 3.0

Novell Inc., 5918 W. Courtyard Dr., Austin, TX 78730; 800-477-9139, 512-795-8094; fax, 512-345-9509

List Price: 16 users (comprehensive package), \$2,195; 5 users, \$795; 10 users, \$1,295; 20 users, \$2,195; 50 users, \$3,995; 100 users, \$5,995; 250 users, \$10,995 (packages for 20 or more users include NetWare Runtime 3.11).

Requires: 4MB free RAM, 1MB hard disk space, NetWare 3.11 or NetWare Runtime 3.11. Client requires: 35K to 80K RAM; DOS 3.3 or later, Macintosh System 6 or later, OS/2 1.3 or later, or Windows 3.x. LAN support: NetWare. Protocol support: ADST (on Mac client), SPX/IPX.

In Short: NetWare SQL is actually a Btrieve application, and Version 6.0 of Btrieve is included with the product. NetWare SQL distinguishes itself through declarative referential integrity enforced at the server and the speed resulting from its tight integration with the underlying NetWare 3.11 operating system; its low price point is also worth noting. But NetWare SQL lacks features such as cost optimization and two-phase commit, and it doesn't have the scalability of other SQL databases.



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Nothing comes close.

SQL Databases

Oracle Corp.

Oracle Server for NetWare

BY JOE SALEMI

Although Version 7 of Oracle Server for NetWare is now near completion, this maker of perhaps the most widely known SQL database hasn't released a new version in nearly two years. Version 6.0 no longer upholds Oracle's reputation for state-of-the-art client/server databases. It lacks features such as cost-based optimization, triggers, and declarative referential integrity, and its server-side memory requirements are about four times greater than any other SQL database in this roundup.

Still, Oracle Server's reliability and solid presence in the corporate world make it a force to be reckoned with on the PC platform. Oracle is known for its outstanding customer support, and there are more than 70 third-party front-end applications that work with Oracle

Server. With Version 7 entering the latter stages of beta testing, market leader Oracle may yet climb back to the top of the technological heap.

EXPENSIVE IN HARDWARE AND SOFTWARE

Oracle Server was not originally designed for PC shops, and its price and system requirements show it. The 8-user version costs \$3,999, the 48-user version costs \$17,999, and the 96-user package tops out at a whopping \$35,999. Only Sybase SQL Server for NetWare costs as much.

Oracle's very high memory requirements add even more dollars to the price of the system. The documentation states that each user connection requires at least 200K to 250K of RAM on the server, but our tests found the RAM requirement to be even higher. The reason is that each user spawns an entirely new process: A new copy of the database management code is created in memory for each new user, rather than sharing code between users. The one-process-per-user technique is a holdover from platforms that

support multiple processors, since it allows the operating system to manage the CPU load. Oracle Server for NetWare, Version 7, should reduce memory requirements by shifting to a code-sharing technique.

We are unable to publish the Oracle Server benchmark test results because Oracle's license agreement requires the company's written permission to do so, and Oracle was unwilling to give that permission. We did run all the benchmark tests, however, and we can give you some top-line performance results.

Because of its memory requirements, Oracle Server was the only product we tested that was unable to perform our Random Read and Random Write tests with our full complement of 36 workstations. The maximum number of connections we were able to achieve with 16MB



SQL Back-End Glossary

DATABASE INTEGRITY

referential integrity (RI) RI means internal consistency within the database; that is, no records that refer to missing records (termed "orphans"). An example of a violation of referential integrity would be a database consisting of both a customer table and an order table, where the customer record for a particular order is missing. RI is maintained through a set of rules, which may be located in the client-side application (least reliable), in a stored procedure on the database server (more reliable), or via a coding scheme within the tables themselves (most reliable).

procedural integrity With procedural RI, referential integrity is enforced by the use of predefined procedures that are automatically executed when certain types of changes are made. Since the integrity rules are stored separately from the database tables, procedural integrity is not the best approach, but it is preferable to relying on the front-end application to enforce RI.

declarative integrity With declarative RI, referential integrity is enforced by the use of primary and foreign keys, which are stored within the database tables themselves and describe the relationships within the database.

TRANSACTION PROCESSING

checkpoint The point at which recent updates stored within cache memory are written to disk is called a checkpoint. Most engines can be configured to perform checkpoints at specific time intervals.

rollback Rollback allows transactions that were only partially completed because of a hardware failure to be discarded, thus restoring the database to its previous (consistent) state. Partial rollback, through the use of save points, can be useful in complex transactions where it is not desirable to discard the entire transaction.

roll forward Roll forward is a feature used for recovery from system crashes. An instance backup (a snapshot of the database) is restored, and then all subsequent changes to the database are reapplied utilizing the transaction log (a description of all changes to the database).

two-phase commit Used in distributed database scenarios, this protocol first checks to see if all of the systems involved in the current transaction are ready either to "commit" or to "roll back." The protocol then passes the appropriate operation to finalize the transaction.

OPTIMIZATION

cost-based optimization This query optimization technique utilizes statistics gathered on the database to estimate how "costly" (in terms of time) possible solutions to a query would be, and then chooses the least costly method for execution.

syntax-based optimization With this query optimization technique, generic rules are used to reword a query so it will execute more quickly. Although, the optimized solution requires programmers' skill and may not be as fast as what cost-based optimization would provide, its advantage is low overhead.

READ CONSISTENCY

record locking and multi-versioning In a multiuser environment where the database is constantly being updated, it is difficult to ensure that a user's view of data is consistent—that is, that all related transactions have been processed. Record locking is one solution, but the price is that other users must wait to gain access to "locked" data (data that another user is currently using). **Multi-versioning** is a solution that uses prior snapshots of the database for read-only access, so users are not locked out during updates.

► SUMMARY OF FEATURES

SQL Databases



Products listed in alphabetical order

■ = YES □ = NO

	IBM Extended Services with Database Server for OS/2	Ingres Server for OS/2	Microsoft SQL Server	NetWare SQL	Oracle Server for NetWare	SQLBase Server NLM	Sybase SQL Server for NetWare
List price (comprehensive package*)	\$3,195.00	\$5,690.00	\$7,995.00	\$2,195.00	\$6,899.00	\$3,995.00	\$12,547.50

Special Features

Stored procedures:							
Compiled SQL stored on server	□	■	■	■	□	■	■
Compiled 3GL code stored on server	■	■	□	□	□	□	□
User can execute stored procedures from command line	□	■	■	■	□	■	■
Stored SQL procedures can use control logic	□	■	■	□	□	□	■
Triggers:							
Number of triggers allowed per SQL statement	N/A	N/A	3	N/A	N/A	N/A	3
Number of times triggers can cascade	N/A	N/A	16	N/A	N/A	N/A	16
Trigger rules can be applied by column	N/A	N/A	■	N/A	N/A	N/A	■
Referential integrity:							
Declarative referential integrity via keys	■	□	□	■	□	■	□
Procedural referential integrity via triggers	□	■	■	□	□	□	■
Domain integrity:							
Can define new data types	□	□	■	□	□	□	■
Domain integrity enforcement on server	■	□	■	□	□	□	■
Backward and forward scrolling:							
Implemented on server	□	□	□	■	■	■	□
Implemented on client	□	□	■	□	□	□	■
Hashed indexes	□	□	□	□	□	□	□
Hashed clustered indexes	□	□	■	□	□	■	■

Programming Features

SQL language:							
Full ANSI SQL compliance level	Level 2 with Enhanced Integrity Addendum	Level 1	Level 1	Level 1	Level 2	Level 2 with Enhanced Integrity Addendum	Level 1
DB2 compatibility	Partial	Partial	Partial	Full	Full	Partial	Partial
SQL command optimization:							
Cost-based	■	■	■	□	□	■	■
Syntax-based	□	□	■	■	■	□	■
3GL language support:							
API available	C, COBOL, FORTRAN, REXX	C	All via call-level library	Assembler, BASIC, COBOL, Pascal	C, COBOL, FORTRAN, Pascal, PL/I	All via call-level library	All via call-level library
Precompiler available	C, COBOL, FORTRAN	C	COBOL	C	C, COBOL, FORTRAN	COBOL	COBOL

Database Management

Database backup and recovery:							
On-line backup	□	□	■	■	■	■	■
Roll forward	■	■	■	■	■	■	■
Roll back	■	■	■	□	■	■	■

N/A—Not applicable. The product does not have this feature.

* This price includes the server program, client software, communications software, and any licensing fees for a 16 user system with DOS clients on a network.

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\$259



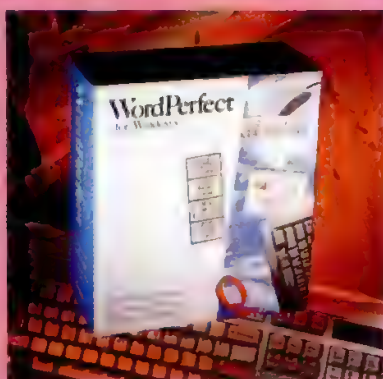
★ WinSleuth Professional 2.0

This new version takes advantage of Windows GDI. Over 40 new features include tests on serial ports, mouse, keyboard, video adapter, RAM, and hard disk drive within the Windows environment; hard disk space utilization; low-level disk details; partition table; VGA information and memory



Statistics under DPM; view DOS level info such as environment details, TSRs, I/O port usage, system resources, device drivers and task list. Publisher: Dariana Technology Group, Inc. UT1704

\$105



★ WordPerfect 5.1 for Windows™

WordPerfect 5.1 for Windows contains all of the capabilities of WordPerfect 5.1 for DOS, as well as new features that take full advantage of the Windows graphical user interface. The Ruler simplifies the tasks of adjusting margins, setting tabs, changing line spacing, selecting styles and creating or modifying columns and tables. WYSIWYG editing lets you see all your graphics and fonts on screen. Graphics can easily be moved and sized by using the mouse. You can assign frequently used features and commands to the Button Bar for easy access. WordPerfect for Windows documents are compatible with WordPerfect 5.1 for DOS. Publisher: WordPerfect Corporation. **WP1653/5**

\$295



ScreenExtender for WordPerfect

Voted #1 WordPerfect Add-On by WordPerfect Magazine readers, ScreenExtender 2.0 solves the most frustrating problem in WordPerfect: the need to scroll the screen left and right while editing. ScreenExtender also allows full page editing and shows underline, italics, subscripts, strikeout, etc. on-screen. Includes six screen fonts, color palette editing, context-sensitive help, and much more. Network versions available. Supports SVGA, VGA, EGA, CGA, Hercules and Gas Plasma graphics standards. **Network 5-Pack WP3744 \$179**. **Network 20-pack WP3754 \$469**. Publisher: Stairway Software. **Single user WP1883/5**

\$59



PC Globe 5.0

PC Globe is a colorful world tour you don't have to leave your desk for. The ideal resource for educators, business people, students, travelers, providing users with instant profiles of 208 countries and dependencies in a single, simple-to-use source. Features include: Topographical and natural features maps; Demographic, economic, political, climate and health data; Travel requirements, tourist attractions, currency conversions. Country comparisons on charts or maps. Easily exported and printed. Now includes Yugoslavia Federation, Croatia, Slovenia, Commonwealth of Independent States (C.I.S.), Baltic States and Georgia. Publisher: PC Globe. **BS1834**

\$37



★ WINFAX PRO 2.0

Now you can send or receive a fax without ever leaving your Windows application! WINFAX PRO is a Windows 3 software program that installs like a printer driver, so you can work in any Windows application and "print" directly to any fax machine anywhere in the world — conveniently and privately. Because it uses Windows, WINFAX PRO takes up no additional memory and is very simple and straightforward to use — and it works with any Windows program. WINFAX PRO also lets you receive faxes within Windows or DOS without interrupting your work. Save faxes, view them on-screen or print them out. Other time-saving features include phone books, activity logs, and group sending. Publisher: Delrina Technology. **FX015+**

\$75

★ AUTOMAP for Windows

AUTOMAP for Windows helps you find the best route for your trip. It's fast, fun and informative with hundreds of up-to-date, color maps right on your computer screen. AUTOMAP searches its massive database of 359,220 miles of roads and highways giving you clear, detailed maps that can get you anywhere in the United States that you want to go. Its driving instructions list all the roads you'll be traveling, exactly how far to go, exactly where to turn and even which signs to look for. Publisher: AUTOMAP, Inc. Also available: **AUTOMAP BS522+ \$50**, **AUTOMAP EUROPE BS650+ \$75**, **AUTOMAP for Windows BS698+**



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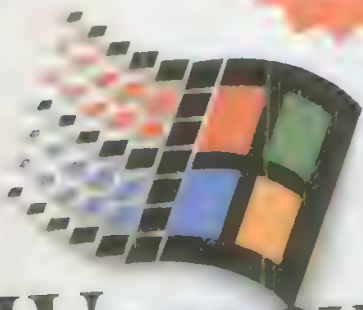
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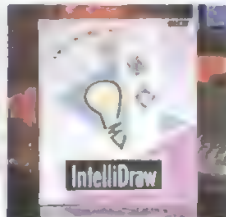
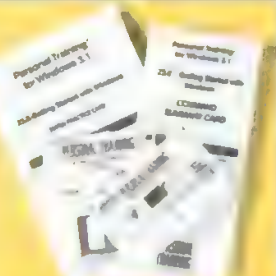
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Publisher: Aldus
G.R.5383

\$199



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Manufacturer: Hayes MM2190

\$479

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Manufacturer: Iomega
DR2240

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Norton Lambert		
CM1035/5	★ Norton Dual Pack I/Windows & DOS	119
Okna Corporation		
BS114	★ The Desktop Set 3.0	79
PC Globe, Inc.		
BS1144	★ PC Globe 5.0	37
BS1144	★ PC SA 2.0	29
Peachtree Software		
PN1064	★ Peachtree Basic Accounting 6.0	75
Polaris		
BS1094	★ PackRat 4.0	259
Power Up Software		
PR1654	★ Calendar Creator Plus 4.0	39
Qualitas		
TR1084	★ 386MAX 6	61
Quarterdeck Office System		
BS1445	★ DesktopView 386 2.4	129
EX1105/5	★ OEMM 386 6.0	61
Reference Software		
WP1014	★ Grammatik Windows	55
Softlogic Solutions		
UT1193/5	★ Software Carousel 6.0	55
Spinmaker Software		
BS1723/5	★ BetterWorking Eight-In-One	32
BS1094	★ BPS Window Works	95
Stainway Software		
UT1093/5	★ ScreenExtender for Word Perfect	59
Symantec		
UT1135/5	★ Norton AntiVirus 2.0	85
UT1135/5	★ Norton Desktop for Windows	99
UT1135/5	★ Norton Advanced 6.01	115
UT1135/5	★ Norton Backup 2.0 for DOS	99
UT1135/5	★ Norton Anywhere 4.5 Host and Remote	115
BS1413/5	★ Q&A 4.0	259
BS1723/5	★ On Target 1.0	255
Technology Interchange Group		
BS1715	★ The Hard Disk Survival Kit	169
BS1065	★ Your PC Inside-Out	169
Telereview		
FN1443	★ M Y O B for Windows	135
Timeslips		
BS1435/5	★ Timesheet Professional for Windows	129
BS1435/5	★ Timeslips 1.4.0	189
Tool Technology Publishing		
TT1113	★ WinTools	125
Touchstone		
UT1114	★ CheckIt PLUS	85
Traveling Software		
LT1174	★ Laptop Pro 4.0	109
Triton		
CM1443/5	★ CO/Session	99
WordPerfect Corp.		
WP1115/5	★ WordPerfect 5.1	269
WP1115/5	★ WordPerfect 5.1 for Windows	295
XTree Company		
UT1174	★ XTree Gold 2.5	99

LANGUAGES

Borland International		
BN1454	★ Borland C++ 3.0	319
BN1454	★ Borland C++ for Windows	319
BN1454	★ Turbo C++ 2nd Edition 3.0	74
BN1454	★ Turbo C++ for Windows	105
Microsoft		
BN1453/5	★ C/C++ Compiler	299
LN1005	★ QuickBasic 4.5	65
LN1674	★ Visual Basic	129

Cardinal PC10 386SX/16

386SX 20MHz w/Color Monitor

\$769

Manufacturer: Cardinal Technologies, Inc. CP0350

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Design Your Own Home: Architecture, Interiors, Landscape



With Architecture, you can draw professional-quality floor plans, side view building plans and structural details in record time, trimming home improvement costs. Architecture automatically calculates all distances, areas, and angles. Interiors is a beautifully simple approach to a more beautiful home. Arrange and rearrange furnishings in seconds. Explore subtle color schemes and variations. Switch from top views to side views. Landscape is easy to use and can help prevent costly mistakes. Position flowers, shrubs, trees, walks, steps, fences, etc. for that look you want. Dozens of sample plans are included with each version. Modify them or create your own. **Publisher: Abracadata Interiors EN2704 \$33. Landscape EN2714 \$33.**

Architecture EN2694

\$33

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\$35

Bodyworks

Now you can explore the human body's systems, structures, and functions in fascinating interactive detail. Includes a special health section with information on first aid, general fitness, sports injuries, and common illness. **Publisher: Software Marketing ED3034 \$49.**



Orbits

Orbits lets you explore the worlds of wonder in outer space. This interactive space simulator and solar system atlas features animation and 3-D graphics. Requires 512K RAM, EGA or VGA color graphics, and supports a mouse. **Publisher: Software Marketing ED3044 \$39.**



★Fontographer for Windows

Now you can add hundreds of variations to your existing font library, and even scan in your own handwriting and save it as a font. Fontographer for Windows - The industry standard for type and logo design on the Macintosh, is now available for Windows users. Whether you begin with a scanned image, open an existing font to edit a single character, change the entire typeface, work with pasted outlines, or draw from scratch - it's easy to design quality type and graphics with Fontographer! With tools like automatic hints, font interpolation, pressure sensitive and calligraphic pen tools, auto-trace, Bezier curves, and an integrated bitmap editor. Fontographer creates downloadable fonts as precise as your original drawings. **Publisher: Altsys Corp. GR5543**

\$265



AUTOWORKS

AUTOWORKS examines the automobile from bumper to bumper, from a basic overview of each system to in-depth graphics and animated sequences of how your brakes, belts, and suspension work. Even the tiniest technological parts are explored and explained. **Publisher: Software Marketing ED3734**



\$49

DesignCAD 3D 4.0

DesignCAD 3D, PC Magazine Editor's choice, and Computer Shopper "Best Buy". Easy-to-use modeling software that allows you to drill, hammer, slice, subtract, and extrude solid and wireframe objects! Also, 3D text and 3D dimensioning! New! "Real Time" view positioning! Great designing tool for architectural, engineering, art, illustration, or hobbies! Plus: Rendering with textures, volume and area calculations, macros, and the basicCAD Programming Language! Includes these valuable extras FREE! Graphic Presentation Utility, Bill of Materials Utility, Digitizer Template, File Transfer Utility to WordPerfect (WPG), PageMaker (HPGL), Renderman, DXF, IGES, GEM, and Postscript! **Publisher: American Small Business Also available for Drafting and Design: DesignCAD 2D 5.0 CA0203 \$175.**



**DesignCAD 3D 4.0
 CA0233**

\$249

Presentation Task Force CGM clip art 4.0

Now you can own the clip art PC Magazine recently called "The best CGM clip art package for overall quality and usability." Presentation Task Force 4.0 is the only clip art product to feature over 3,500 high quality, color illustrations in one value packed, comprehensive volume! Use PTF clip art to enhance presentations, newsletters, and spreadsheets created with over 60 leading DOS and Windows applications, including CorelDraw! Designer, Harvard Graphics, Microsoft Publisher, PageMaker, Persuasion, PowerPoint, Quattro Pro, Ventura Publisher, Word for Windows, WordPerfect, and many more! PTF 4.0 contains people, animals, business symbols, medical illustrations, holidays, sports, military, and environment related images. **Publisher: New Vision Technologies, Inc. GR3174**

\$134



CheckIt PLUS

CheckIt PLUS makes the world's best diagnostic software even more powerful. CheckIt reports your system's configuration, runs tests, and benchmarks your system. You can save time and money by skipping a trip to the repair shop and fixing the problem yourself. CheckIt 3.0 now includes MenuWorks by PC Dynamics, and MBC's Disk Labeler Supreme. With the additional software, you can organize your hard drive and floppies making your system easier to use, and improve performance. Also available: **CheckIt LAN (5 user) UT2230 \$89.** **Publisher: Touchstone**



CheckIt PLUS UT0734

\$85

► SUMMARY OF FEATURES

Products listed in alphabetical order							
■ = YES □ = NO	IBM Extended Services with Database Server for OS/2	Ingres Server for OS/2	Microsoft SQL Server	NetWare SQL	Oracle Server for NetWare	SQLBase Server NLM	Sybase SQL Server for NetWare
Database Management (cont.)							
Separate mirroring of transaction log and database	□	□	■	■	□	□	■
Transaction logs can be stored on separate device	■	■	■	■	■	■	■
Security:							
Assign access by group	■	□	■	■	□	□	■
Assign access by user	■	■	■	■	■	■	■
Disk file management:							
Supports data types larger than 2GB	□	□	□	□	□	■	□
Spanning of database	□	■	■	■	■	■	■
Spanning of transaction log	□	□	■	■	■	□	■
Striping of database	□	■	■	■	□	■	■
Striping of transaction log	□	□	■	■	□	□	■
Asynchronous I/O	■	■	■	■	□	□	■
Multuser Features							
Locking granularity:							
Record-level	■	□	□	□	■	□	□
Page-level	□	■	■	■	■	■	■
Table-level	■	■	■	■	■	□	■
Automatic lock escalation	■	■	■	□	■	■	■
Minimum page size	4K	2K	2K	512 bytes	2K	1K	2K
Read consistency levels:							
Cursor stability	■	■	■	■	■	■	■
Repeatable read	■	■	■	■	■	■	■
Multi-versioning	□	□	□	□	□	■	□
Release locks after reading	■	■	■	■	■	■	■
Uncommitted ("dirty") reads	■	■	□	□	□	□	□
Deadlock detection:							
Cost-based	■	□	■	□	□	□	■
Aborts transaction that caused deadlock	■	■	■	■	■	■	■
Aborts via timeout	■	■	□	■	■	□	□
Platforms and Connectivity							
Can connect to other servers	■	□	■	■	■	■	■
Can connect to other platforms	Optional	Optional	■	□	■	■	Optional
Can join tables stored on different servers	□	□	□	■	■	□	□
Can join tables stored on different platforms	□	□	□	□	■	□	□
Two-phase commit	□	□	■	□	□	□	■
Training and Tech Support							
Training available	■	■	■	■	■	■	■
Around-the-clock technical support	□	■	■	□	■	□	■
Cost for technical support	Varies	15% of price, \$3,000 minimum	Varies	Free	15% of license fee	Varies	\$7,000 for 1 year



ENDS

SQL Databases

SUITABILITY TO TASK				
Oracle Server for NetWare				
	PL/SQL	SQL	SQL*NET	SQL*PLUS
Mission-critical tasks	●	●	●	○
SQL programming	●	●	●	○
Connectivity and portability	●	●	●	●
Data storage	●	●	●	○
Transaction processing	●	●	●	○

of server RAM was 29, which left no room for the database cache. So we chose to optimize for the highest throughput rates and settled on a configuration of 16 maximum connections, which translates into a full 1MB of RAM per user. With the caveat that Oracle Server was given a memory resource advantage on these tests, we can say that the product performed very well.

A FEATURE SET WITH HOLES

Oracle Server is one of the two products in this roundup (Ingres Server for OS/2 is the other) that does not provide server-based enforcement of referential integrity (RI). While Version 6.0 has the syntax for declarative RI, it is not supported by the database engine and is therefore unusable. (Declarative RI is planned for Version 7.) Nor does Oracle Server provide procedural RI, since it doesn't support triggers. In short, the responsibility for ensuring referential integrity with Oracle Server falls to the front-end application programmer.

Oracle Server is also the only SQL database we reviewed that does not support cost-based optimization; syntax (or rule-based) optimization is the only type supported. Cost-based optimization is another important enhancement planned for Version 7.

Oracle does provide some useful features that other SQL databases lack. Its enhanced version of SQL, called PL/SQL, extends the ANSI standard with syntax for error handling, looping, and branching. It also lets programmers send blocks of statements to the server at once, which speeds up network performance because there's less frequent communication between the client and server. PL/SQL code can be easily ported from one Oracle platform to another; the programmer need only recompile the application on the new platform.

Oracle Server also has a convenient array feature. With other database products, the results of a query are usually delivered to the client a row at a time. If the result set is 100,000 rows, this can be very inefficient. Oracle Server's array feature lets you retrieve more than one row at a time. For example, a 100,000-row result set could be retrieved in chunks of 1,000 rows each. The array feature is not limited to queries; it can also be used for inserting data, which can make the programmer's job much easier.

MULTIPLATFORM SUPPORT

Oracle's database management package has been ported to more than 100 platforms since its development on a Digital Equipment Corp. VAX under VMS, making it especially scalable. Oracle Server's ubiquitous presence makes it easier to move your database to a bigger (or smaller) computer if your business so warrants.

Oracle's SQL*Net communications software provides cross-device support; users can create joins between tables stored on different servers, or even different platforms. Table locations are stored

on the server, and lookups take place transparently when a query is issued. For tables duplicated on separate servers, an option lets users specify which table to use. It's important to point out, however, that since Oracle Server does not provide cost optimization for these cross-device queries, joins that are written inefficiently can put a tremendous burden on the network. Cross-device support is for queries only; multisite data modification is not possible.

While Oracle's price is high and the technology is not presently cutting-edge, the company's history of rock-solid products and reputation for superlative customer support make it premature to write off Oracle Server—especially with the imminent release of Version 7. Still, unless your business already uses Oracle Server on other platforms, we recommend waiting for the new version with all its promised features, or choosing a more state-of-the-art product.

Gupta Technologies Inc.

SQLBase Server NLM

BY JOE SALEMI

Gupta Technologies' SQLBase Server NLM, Version 5.0.2, incorporates state-of-the-art features, including declarative RI, on-line backup, cost-based optimization, hashed clustered indexes, data compression between client and server, and true forward- and backward-scrollable cursors. There are versions for four different platforms: DOS, OS/2, NetWare, and Unix; the same SQL code will work across all platforms. The DOS version of SQLBase supports local databases, letting developers create front-ends on standalone DOS computers without requiring a LAN. Since Gupta has versions for both OS/2 and NetWare, we asked the company to choose which version we should review; it chose the NLM.

Gupta's SQLBase is unique among the products in this roundup in that it was developed specifically for the PC platform. While other vendors struggle to maintain only one code base to run across



FACT FILE

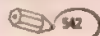
Oracle Server for NetWare,
Version 6.0

Oracle Corp., 500 Oracle Pkwy., Redwood Shores, CA 94065; 800-672-2531, 415-506-7000; fax, 415-506-7809.

List Price: 16 users (comprehensive package), \$6,899. 8 users, \$3,999, 16 users, \$6,899, 32 users, \$11,999. 48 users, \$17,999, 64 users, \$23,999, 96 users, \$35,999.

Requires: 16MB RAM, 10MB hard disk space, NetWare 3.11. Client requires: 70K RAM, DOS 3.31 or later, OS/2 1.21 or later, or Windows 3.0 or later. LAN support: NetWare 3.11 Protocol support. SPX/IPX (included), TCP/IP.

In Short: Its maturity, stability and multiplatform support make Oracle Server a viable choice for downsizing large databases. The technology of the current version, however, lags behind its competitors on the PC platform, and its hardware requirements are unusually steep. Weaknesses—such as extraordinarily high memory requirements, no cost-based optimization, and no support for stored procedures—will be rectified in Version 7, to be released sometime in 1993.



ON READER SERVICE CARD

SQL Databases

SUITABILITY TO TASK

SQLBase Server NLM

	POOR	FAIR	GOOD	EXCELLENT
Mission-critical tasks	●	●	●	●
SQL programming	●	●	●	○
Connectivity and portability	●	●	●	○
Data storage	●	●	●	●
Transaction processing	●	●	●	○

all platforms—sometimes sacrificing performance in the process—Gupta's products encounter no such constraints.

HIGH TECHNOLOGY, HIGH SPEED

One of the special features of SQLBase is its support of hashed clustered indexes. Hashed clustered indexes can greatly enhance performance because they are determined by a function, so records can be retrieved in a single I/O rather than the multiple I/Os needed with conventional indexes. Hashed clustered indexes depend on the physical arrangement of the data, so there can be only one per table. With a nonclustered hashed index (not supported by any of the products in this roundup), multiple hashes per table are possible.

The speed of SQLBase can be further improved by compressing messages between the client and server. This is especially useful when storing image data, a feature that Gupta supports. Since compression adds overhead, speed gains are application-dependent, so the use of compression is optional.

SQLBase's read-only option is another handy feature to reduce overhead when the database is used for lookups only. The read-only option would be useful, for example, with a decision-support system on CD-ROM.

Precompiled code stored on the server can make a SQL database faster as well provide other advantages, such as central storage of business rules. Gupta's *chained SQL* capability, while not as powerful as the stored procedures provided by Ingres, Microsoft, and Sybase, lets programmers store SQL statements on the server, where they can be accessed by any application. Multiple ("chained") statements can be executed with a single call to the database, but there is no support for branching or looping logic.

Because of its advanced features,

Gupta is rumored to have one of the fastest SQL database systems, and we were eager to test that assertion in our tests. The benefits of SQLBase's hashed clustered index support were evident in the results of our Random Write test, which performs concurrent updates on random rows of a table. The only disappointment was in the area of data loading; SQLBase's workstation-based loading facility took almost 10 hours to load our test database. Gupta is currently revising the utility, and promises performance improvements in future versions.

SERVER-BASED REFERENTIAL INTEGRITY

Referential integrity (RI), a key component of the relational database model, means that changes to the database are appropriately reflected throughout every table. If a record is deleted or updated, it must be deleted or updated everywhere or the operation must be disallowed. Some SQL database systems (such as Oracle Server) require the front-end application programmer to provide the logic for RI, while others (including Microsoft SQL Server and Sybase SQL Server) implement RI through stored procedures and triggers.

SQLBase implements *declarative referential integrity* through *foreign keys* in the dependent tables that are components of a unique *primary key* in the parent table. This is the preferred implementation, as specified in the ANSI Integrity Enhancement addendum, since the relationships between tables are stored within the tables themselves.

Gupta's language extensions let you specify how a DELETE is handled when RI is active. You can prevent the deletion of a parent row if dependencies exist (via the RESTRICT option), automatically delete dependent rows when the parent is deleted (via the CASCADE option), or set the values of the foreign key column in the dependent table to NULL when the parent is deleted.

While the server memory requirements of SQLBase are only 10K per connection (compared with 50K for Sybase SQL Server or 250K for Oracle Server), SQLBase pays for this low overhead on the client side. The current version reduces client-side memory requirements from more than 250K to just under 200K, but this is still very high; there is very little

room to run real-mode front-end applications. It's no coincidence that the two primary front-end tools marketed by Gupta are Windows-based, where the 640K DOS limit is circumvented.

A SERVER WITH THE PC IN MIND

Gupta's SQLBase Server and Novell's NetWare SQL are the only SQL databases in this review that support true forward- and backward-scrollable cursors as part of the engine. (Both the Microsoft and Sybase SQL Server products provide front-end calls that can emulate backward scrolling using a buffer on the client side.) Backward scrolling is a capability that wasn't very relevant in character-mode environments, but has achieved new importance with today's sophisticated, graphical front-end tools.

SQLBase lets you scroll backward through data as quickly and easily as you can scroll forward. With a traditional SELECT query, the database returns one row at a time, starting at the beginning and scrolling forward to the end. Competing products (including both versions of SQL Server) provide functions that

FACT FILE

SQLBase Server NLM,
Version 5.0.2

Gupta Technologies Inc., 1060 Marsh Rd.,
Menlo Park, CA 94025; 800-876-3267, 415-
321-9500; fax, 415-321-5471

List Price: 16 users (comprehensive package), \$3,995; 5 users, \$995; 20 users, \$3,995; unlimited users, \$7,995.

Requires: 8MB RAM, 10MB hard disk space, NetWare/386 3.11 or later. Client requires: 50K RAM, DOS 3.3 or later, OS/2 1.21 or later, or Windows 3.x. LAN support: Banyan VINES, IBM LAN Server, Microsoft LAN Manager, NetWare, 3COM 3+Open. Protocol support: APPC, Named Pipes, NetBIOS, SPX/IPX, and TCP/IP.

In Short: SQLBase Server 5.0.2 boasts advanced features such as declarative referential integrity, hashed clustered indexes, and true forward- and backward-scrollable cursors. Its unique data compression capability makes a fast engine even faster. And to top it all off, it's one of the least expensive options in this roundup. The product's one notable limitation is the paucity of third-party front-end access tools.



ON READER SERVICE CARD

SQL Databases

simulate backward scrolling by storing part of the results—which can be thought of as bookmarks—in a buffer on the client computer. Using this method, what appears to be backward scrolling is actually an additional query that rereads data starting at the appropriate bookmark. While this method works, it makes backward scrolling slower than forward scrolling, since an additional query is needed.

In contrast, Gupta's "scrollable cursor" is implemented through the use of a temporary result table, where multiple rows of query-result data are stored. Users can scroll forward and backward through the temporary result table at will. And they are not limited to browsing: Data can be inserted, updated, or deleted through this function. The scroll option is off by default, since it adds some processing overhead.

Gupta's SQLBase is a technology leader with many appealing features. It's fast, and it's one of the least expensive of the products we reviewed. Its one notable limitation is the relative paucity of third-party front-end applications, especially compared with those for SQL Server. Still, Gupta's features, price, and performance make it an excellent choice.

Sybase Corp.

Sybase SQL Server for NetWare

BY BRIAN BUTLER

Sybase SQL Server for NetWare and Microsoft SQL Server for OS/2 were developed from the same code base. Sybase is well known for its popular Unix version of SQL Server. Microsoft licensed the code base from Sybase and ported SQL Server to OS/2. The current version of Microsoft SQL Server brings the version numbers in sync, underscoring the commonality between the two products.

Sybase SQL Server is the latest entry into the PC-based SQL database market, and it may well be the best. Sybase combines the advanced features of SQL Server (see the review of Microsoft SQL Server) with the impressive speed of an NLM to produce a stellar product.



THE SAME, BUT DIFFERENT

Sybase SQL Server and Microsoft SQL Server have identical feature sets; the products differ only in platform, price, and packaging. But what a difference a platform can make! Our benchmark test data shows Sybase SQL Server to be one of the fastest SQL databases we tested. Its performance on the Random Read and Mixed Workload tests was especially strong, with throughput rates that outshined all the rest. The product was less impressive on the Random Write test, since it does not support record-level locking. The one test on which Sybase SQL Server did not perform well was the Load and Index test—though the reason for its lack of speed will soon be corrected. The SQL Server BCP (Bulk Copy Program) currently executes on the workstation, which makes it slow for large imports. An NLM version of the loading utility, which will unquestionably be much faster, was in beta testing at the time of our review.

Two other major differences between the two is pricing and packaging; if you want the speed advantage of Sybase SQL Server, you'll have to pay for it. An unlimited-user license for Microsoft SQL Server sells for \$7,995, with no additional per-client charges. The cost of an unlimited user license for Sybase SQL Server starts at \$29,995. But this does not include the cost for each client workstation (\$290 per workstation, less a 25 percent discount when purchasing more than one), or any of the extras that Microsoft bundles at no additional charge.

Along with the standard, character-based administration tool, Microsoft bundles a Windows-based administration tool with a real-time system monitor that provides ongoing updates to the screen. This tool doesn't work with the Sybase product because the tool depends on an OS/2-hosted server-side daemon to provide the ongoing system information.

Microsoft also bundles Open Database Services, a means for communicating beyond the network, at no extra charge. Sybase offers a similar product on the Unix platform called Open Server that (unlike the Microsoft product) can be used for cross-platform development. Sybase Open Server is not yet available on the NetWare platform, but when it is, it will be sold for an additional charge.

SUITABILITY TO TASK				
Sybase SQL Server for NetWare				
	POOR	FAIR	GOOD	EXCELLENT
Mission-critical tasks	●	●	●	●
SQL programming	●	●	●	●
Connectivity and portability	●	●	●	○
Data storage	●	●	●	●
Transaction processing	●	●	●	●

THE MICROSOFT/SYBASE PARTNERSHIP

A NetWare product is something of a departure for Sybase, a company that has traditionally concentrated on larger computers. Microsoft and Sybase joined forces to conquer the PC marketplace with SQL Server for OS/2. Microsoft licensed the code base from Sybase, ported the product to OS/2, and used its legendary marketing skills to promote it. The result is that SQL Server is a market leader supported by more third-party front-end vendors than any other SQL database.

The original agreement between Microsoft and Sybase gave Microsoft the right to port SQL Server to Microsoft operating systems (which at that time included OS/2), while Sybase was responsible for all other platforms. Since then, IBM has reclaimed OS/2 and Microsoft has begun development of Windows NT, an operating system that will run on more platforms than just the Intel-based PC. It's no longer a simple matter of Microsoft distributing the PC-based products, while Sybase provides an upgrade path.

So Sybase will take primary responsibility for the 32-bit OS/2 2.0 upgrade, although the product will still be distributed by Microsoft. There will not be a 32-bit OS/2 2.0 version of Version 4.2 of SQL Server, but the 16-bit version will soon be certified for OS/2 2.0. The first 32-bit OS/2 2.0 version of SQL Server will be Version 5.0. Both companies are working on NT versions; Microsoft is working on the Version 4.2 port, and Sybase is working on Version 5.0.

THE HAZARDS OF PORTING FROM UNIX

The disadvantages of Sybase SQL Server lie in its Unix roots; although it's a PC product, the company has yet to adopt the PC mentality. In the PC world, users expect the installation process to include automatic (or near-automatic) system

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FACT FILE

Sybase SQL Server for NetWare, Version 4.2

Sybase Corp., 6475 Christie Ave.,
Emeryville, CA 94608; 800-879-2273, 510-596-3500; fax: 510-658-9441

List Price: 16 users (comprehensive package), \$8,995; 1 user, \$1,995; 8 users, \$4,995; 16 users, \$8,995; 32 users, \$15,995; unlimited users, \$29,995.

Requires: 12MB RAM, 16MB hard disk space, NetWare 3.11. Client Requires: 2MB RAM. LAN support: NetWare. Protocol support: SPX/IPX, TCP/IP.

In Short: Sybase SQL Server for NetWare brings the advanced Sybase technology that has long been available on Unix (and more recently on OS/2, via the Microsoft port) to NetWare as a speedy NLM. Although it's not the cheapest option, Sybase SQL Server's advanced features, high speed, and broad support from third-party front-end vendors make it an especially attractive choice.



ON READER SERVICE CARD

configuration; the Unix world accepts configuration hassles as part of the trade-off for peak performance.

The Sybase SQL Server client configuration process provides a good example: The system administrator must create a file with information on the server name, network address, node address, and query port. This is an unnecessary inconvenience, since the program could obtain this information directly from NetWare by supplying just the server name. The use of a configuration file is a holdover from the Unix world, where it is typical to require a "host file" that contains the node's alias and TCP/IP address.

The Sybase SQL Server documentation also shows the Unix influence. While the information is all there, explanations tend to be terse, and a high level of knowledge is assumed. Microsoft's documentation is much friendlier, and includes explanations of the technology and how various pieces fit together.

But in the scheme of things, these are minor quibbles. Sybase delivers the goods: stunning speed, a state-of-the-art feature set, and massive front-end vendor support. The collaboration with Microsoft may confuse some buyers, but the numbers speak for themselves. Sybase SQL Server is an excellent product. □

Programming

UTILITIES

Execute Programs Remotely on Your LAN Server's CPU

BY DOUGLAS BOLING

Although PC LANs let us share files, printers, and other services attached to a central server, they lack one important capability of Unix-based local area networks: the ability to execute programs on another machine. From your keyboard, if you run a program stored on a PC LAN server's disk, the program runs on your local CPU. This limits the execution speed of the program to that of your own system. Wouldn't it be nice if you could run your program using the server's faster CPU instead?

Many Unix installations permit a workstation to execute a program on another machine. The obvious advantage of this procedure is that programs can be run on the fastest machine available. Moreover, applications that access large amounts of data can be executed on the machine where the data is located, thereby lowering the demand on the LAN. And, as a bonus, you can run another application on your machine while the server is executing the requested program.

REDD.SYS, this issue's free utility, brings these Unix-style benefits to PC LANs. REDD is a Remote Executable Device Driver that allows you to execute programs on a LAN server just as if you had entered their commands from the server keyboard. REDD is easy to install and is compatible with DOS-based LAN programs such as NetWare Lite and LANtastic. However, heavy-duty server programs such as Novell's NetWare, which replace DOS when they run, are incompatible with REDD.

Apart from compatibility, there's another reason why REDD was designed for the smaller LAN environment. PC

LAN servers are usually fast 486 machines with huge disks and lots of memory. In a large LAN installation, the server will be kept busy just handling user requests for disk data and printer services. Moreover, in a corporate environment LAN security is often paramount, so LAN administrators can't give users access to the server. On small LAN setups, however, there are only a few users and all of them know the system. Here, an ultrafast server usually idles along,

*You can take advantage
of an underworked
server's CPU speed
by using this
handy device driver.*

wasting vast CPU power that REDD could turn into higher productivity.

The fastest way to get REDD.SYS, its assembly source code (REDD.ASM), and its documentation (REDD.DOC), is to download them from PC MagNet as explained in the sidebar "Utilities by Modem." All three are also available archived as REDD.ZIP. If you don't have a modem, you can request the files on-disk. Just send a postcard with your name, address, and preferred disk size to

Katherine West, Utilities, PC Magazine, One Park Ave., New York, NY 10016. No phone calls, please. To construct the executable file from the source code requires an assembler compatible with Microsoft's MASM 2.0.

USING REDD REDD is installed the same way as any other device driver—by adding a line to the server's CONFIG.SYS file. The full syntax for REDD.SYS is

```
DEVICE=[d:\ ][path\ ]REDD.SYS
```

Once it's installed, REDD looks like a small (2,560 bytes) RAM disk to the server. In addition to the line in your CONFIG.SYS file, you must make any configuration changes necessary in the server's LAN program to allow the various LAN stations to access the REDD disk. This two-step process completes the installation.

To use REDD, you must first create an ASCII file that consists of a list of commands to be executed, in order, by the server. This command file must be named KEYBOARD.IN. It is similar to a simple batch file, except that it lacks such specialized batch commands as Goto. A sample KEYBOARD.IN file is shown in Figure 1.

All you need to do now is copy the command file to the REDD disk. As soon as REDD sees that a KEYBOARD.IN file has been copied to it, it sends the contents of the file to the server's BIOS keyboard buffer. To the server, therefore, it appears as if you were simply typing in the commands directly on the server's keyboard. After processing the KEYBOARD.IN file, REDD erases it.

If REDD is in the middle of processing a KEYBOARD.IN file from another

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SAMPLE KEYBOARD.IN FILE

```

rem
rem Comments can be inserted in KEYBOARD.IN files, COMMAND.COM
rem ignores REM statements. Think of the KEYBOARD.IN file as a
rem script file you would pipe to a program.
rem

rem
rem Assemble REDD using server's CPU. Directories are specified from the
rem server's point of view because I don't know the server's PATH.
rem

c:
cd \projects\redd
d:\lang\masm\masm redd;
d:\lang\masm\link redd;
c:\dos\exe2bin redd redd.com

rem
rem You can also use FOR statements, just remember to use only one % sign
rem

for %a in (*.bak) do del %a

rem
rem IF statements can be used, but GOTO statements don't work.
rem

if EXIST *.tmp del *.tmp

rem
rem The following statements show how to enter a program and exit
rem using a function key.
rem
rem NOTE! Once we are in WordPerfect, we can't use REM statements.
rem They only work when talking to COMMAND.COM. The graphics character
rem is an F7 to exit WP.
rem

d:\wp\wp c:\temp.fil
Now is the time for all good men to come to the aid of their country.
_L
Temp file long name
doc

Y

rem
rem Back to COMMAND.COM
rem
type c:\temp.fil

del c:\temp.fil

```

Figure 1: The KEYBOARD.IN file contains a list of commands to be executed, in order, by the server.

user, the new KEYBOARD.IN file will overwrite the file that is currently being processed. To avoid this danger, you should first determine whether a KEYBOARD.IN file is already on the REDD drive before copying a new file to it. A simple DIR inquiry will suffice.

Because you may have to include non-standard characters—function keys, for example—in your KEYBOARD.IN file, REDD provides a method to pass these keystrokes to the server. The keycodes used to send these non-ASCII keys consist of the scan code of each key plus 80h. For example, to pass an F10 keystroke to the server keyboard, you would put

byte C4h in KEYBOARD.IN. (The scan code for the F10 key is 44h, which, when added to 80h, equals C4h.) REDD subtracts the 80h and places the remainder in the scan code portion of the keystroke. The scan code, along with a zero for the ASCII field, is then stuffed into the server's BIOS keyboard buffer.

REDD is not designed for applications such as word processing, where you need to interact continuously with the screen. It's designed to speed the execution of compilers and the like, which produce output files. At the same time, when your commands execute you do need to be able to see the server's response on

your monitor. Thus, on its RAM disk, REDD creates a read-only file called SCREEN.OUT. This file stores the last 1,024 bytes of data printed on the server's screen. Note that REDD captures screen data written using the BIOS video services only, and not that which an application might write directly to the screen. You can TYPE the SCREEN.OUT file to see it on your display, or copy it to your disk and call it up from there.

One warning is in order. Although ANSI.SYS uses the BIOS routine to write to the screen, it does not use the carriage return and line-feed characters to terminate each line. REDD makes an attempt to interpret screens written under ANSI.SYS correctly, but it is sometimes unable to capture them perfectly.

Aside from the files KEYBOARD.IN and SCREEN.OUT, the REDD disk acts like any other RAM disk. Small files can be copied to and from it, though you must remember that any files copied to the REDD disk will take up disk space that could be used for a KEYBOARD.IN file.

DEVICE DRIVER OVERVIEW Before discussing how REDD works specifically, it's a good idea to talk a little about device drivers in general. In its 1.x versions, DOS accessed the hardware of the machine directly. This led to the need for many different flavors of DOS, each customized for a specific machine. The DOS code itself had to be rewritten for every new type of disk drive attached to the machine.

The device driver concept, which came from Unix, was introduced in DOS 2.0. It isolated the DOS kernel code from the hardware by introducing a layer—the device driver—between them. DOS would talk to the device driver through a standard interface. The driver, in turn, would talk to the hardware. Changes in the hardware would force changes in the device driver, but no changes would be needed in the DOS kernel itself.

Two types of device drivers were designed: *character* and *block*. The character device driver is used to interface with devices that provide serial access; that is, with devices in which data is sent and received as a series of bytes. Printers and serial ports use character device drivers. Block drivers, on the other hand, are used where data on the attached device can be addressed by means of numbered blocks

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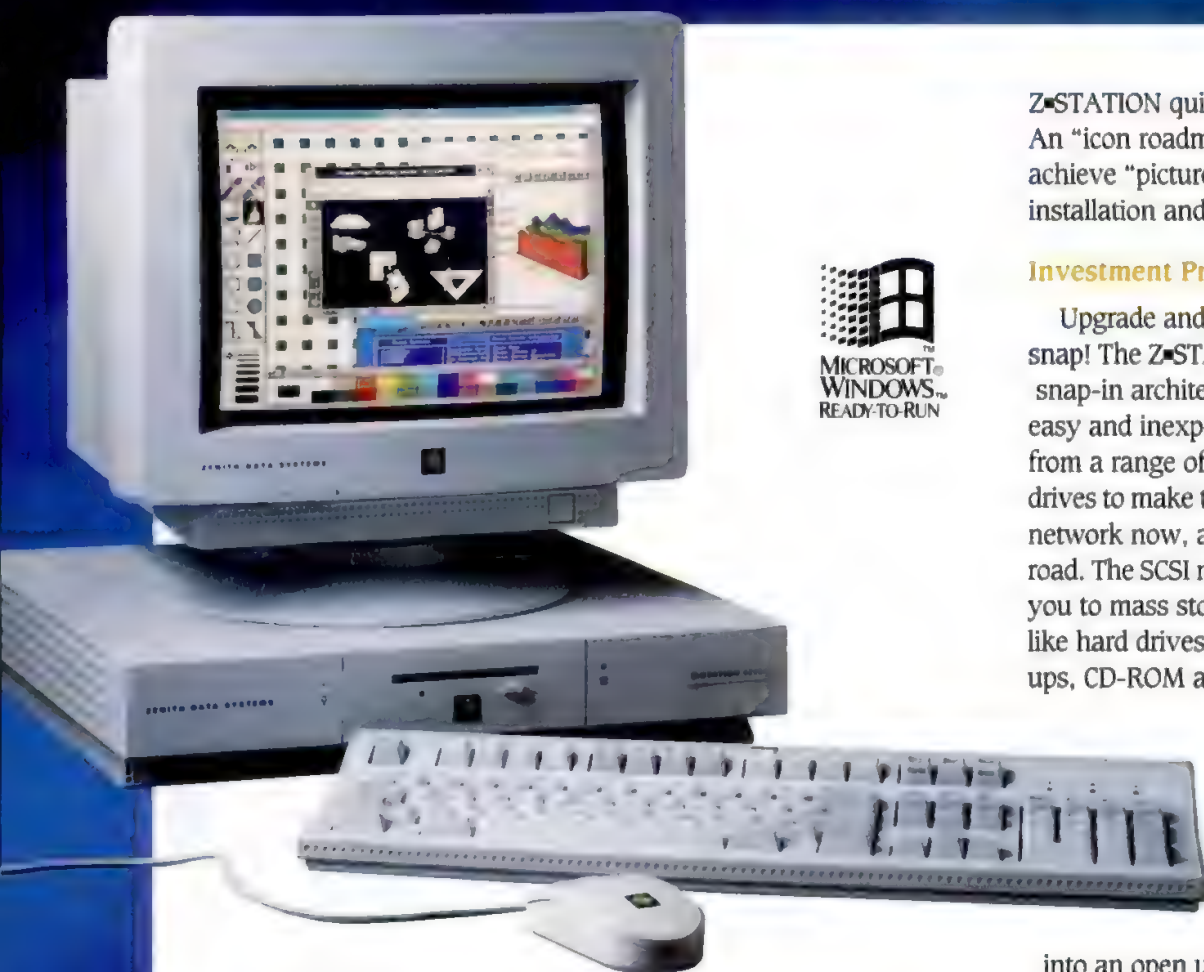
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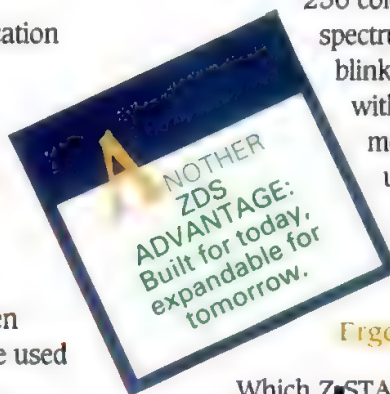
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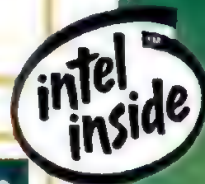
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of bytes. The most common use for block drivers is to interface disk drives, where each sector can be individually addressed.

All device drivers have three main sections: a header, a strategy routine, and an interrupt routine. Located at the start of the file, the header contains fields that define the characteristics of the driver, state its name, and provide pointers for the strategy and interrupt routines.

The header starts with a double word (4-byte) field that initially contains FFFFFFFFh. When the driver is installed, DOS modifies this field to point to the next device driver. The successive linking of the device drivers produces the device driver chain. DOS uses this chain to find individual drivers by simply hopping from driver to driver, checking the driver name or device number of each in turn. Since all device drivers are linked, DOS only needs to keep a pointer to the first driver in the chain (usually the NULL driver) to find any other driver.

The attributes field in the driver header defines the characteristics of the driver; for example, whether it is a character driver or a block device driver. The next two fields hold near pointers to the strategy and interrupt routines.

The meaning of the bytes in the final header field, NameOrUnits, depends on whether the driver supports a block or a character device. For a block driver, the NameOrUnits field contains the number of devices the driver supports. For a character device driver, on the other hand, this field contains the ASCII name of the

device, padded with spaces to make an eight-character name. If the name found here is the same as that of a previous driver, the new driver replaces the old. This allows user-installed character drivers to replace the default character DOS drivers. Unlike character drivers, however, block device drivers cannot replace previously installed block drivers.

For each function call from DOS to a device driver, DOS makes far calls both to the Strategy and Interrupt routines. The Strategy routine simply stores a pointer to a request packet, which contains the function to be executed, along with any necessary information. The Interrupt routine is then called to execute the function.

While the overall format of the request packet differs for each function, the first 13 bytes are the same for all functions. Figure 2 shows this standard portion. The rhLength field specifies the length of the packet, including any function-specific fields. The rhUnit field is used when calling a block driver to specify the drive being addressed. The rhFunction field contains the function number being requested. The rhStatus field is filled in by the driver to return status information to DOS.

After calling the Strategy routine, DOS calls the Interrupt routine to execute the function contained in the request packet. Figure 3 lists the device driver

Standard Request Packet Information

requestheader struc		
rhLength	db ?	;Size of packet
rhUnit	db ?	;Drive addressed (Blk only)
rhFunction	db ?	;Requested function
rhStatus	dw ?	;Returned status
rhReserved	db 8 dup (?)	
requestheader ends		

Figure 2: The fields shown above are the first 13 bytes that are common to all function request packets.

functions used in REDD and their associated request-packet formats.

To implement the complete list of functions would be a considerable chore, but fortunately for programmers, only a subset of the functions are really necessary for most drivers. Further, some of the functions are used only by character device drivers, while other functions are used only by block device drivers.

One function that must be implemented by all drivers is the Init function. Init is called only once, at the time when the driver is being installed. The Init function must parse any parameters on the driver command line, hook any necessary interrupts, and reserve the necessary amount of memory for the driver. Since it is called only during installation, the Init code is usually placed at the end of the driver. This allows it to be discarded after having been called.

To reserve memory, a driver must fill in the irEndAddress field with the segment:offset of the first free byte of memory after the driver. Starting with DOS 5.0, DOS initializes this field with a pointer to the first unavailable byte of memory above the driver. This lets a device driver determine whether there is enough memory to load. Under DOS 5.0, a driver checks this field for enough available memory, then modifies it to specify how much of the memory it needs to reserve.

In the irParmAddress field, DOS passes a pointer to the first character after the equal sign in the DEVICE= line in the CONFIG.SYS file that loaded the driver. The driver must thus scan past the rest of the name to determine whether any additional command line parameters were specified. The line is terminated by a carriage return (0Dh) or a line-feed character (0Ah).

PC Magazine Utilities Updates

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 BAT2EXEC.COM, Version 1.5
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 CARDFILE.COM, Version 1.1
 CHKFRAG.EXE, Version 1.7

CONFIG.CTL, Version 3.0
 DIRMATCH.COM, Version 3.1
 EMMA.COM, Version 2.2
 EMS40.SYS, Version 1.1
 PCACCESS.EXE, Version 1.1
 RN.COM, Version 3.0
 SCHEDULE.COM, Version 1.1
 SLICE.COM, Version 1.3
 SNIPPER.COM, Version 1.2
 ZCOPY.COM, Version 1.4

For a list of all the programs available from Library 0 New Uploads of PC MagNet's UTILFORUM, download PCMCAT.ZIP. □

For block drivers, DOS passes the first available drive number in the `irDriveNumber` field. This number, starting with 0, lets a block driver know which drive letter it has been assigned. For example, if the `irUnits` field contains 4, the first drive letter for the block device is E:. Block drivers should modify the `irDriveNumber` field to indicate how many drives it supports. If the driver supports more than one drive, the drive letters are consecutive, starting with the number passed in the `irUnits` field.

A block driver must return an array of pointers to a BIOS Parameter Block (BPB) for each drive the driver supports. The BPB tells DOS about the physical structure of the block device; for example, the number of tracks, heads, and cylinders. In the case of a RAM disk, these parameters are simply values convenient to the driver, since there is no physical disk.

To complete the Init function (and actually all functions), the driver must return a status word in the `rhStatus` field of the request packet. The status word consists of a high byte containing status flags and a low byte containing an error code. Bit 15 is the error flag; if set, the low byte of the status word contains the code for the error. Bit 9, the Busy bit, indicates that characters are available in character devices. The Done bit (bit 8) indicates that the driver has completed the requested function.

Functions 01 and 02, Media Check and Build BPB, are used only by block drivers; character drivers need only set the Done bit in the status word and return. DOS calls the Media Check function to determine whether the disk has been changed since the last read or write. The driver returns a -1 in the `mrReturn` field of the request packet if the disk has been changed, and a 1 if the disk has not been changed since its last access. If the driver does not know whether the disk has been changed, it returns a 0. For block drivers that support the Open and Close device functions, a pointer to the disk volume label should be returned in the `mrVolumeID` field of the request packet.

DOS uses the Build BPB function to obtain a pointer to a valid BIOS Parameter block for the specified device. DOS makes this call whenever the Media Check function indicates that a disk has

Device Driver Functions

1 of 2

Function

00 Init Character and Block drivers

		Input	Output
<code>irLength</code>	Byte	Length of structure	
<code>irUnit</code>	Byte		
<code>irFunction</code>	Byte	0	
<code>irStatus</code>	Word		Returned status
<code>irReserved</code>	8 Bytes		
<code>irUnits</code>	Byte		
<code>irEndAddress</code>	DWord	Ptr to 1st res byte	Ptr to byte past driver
<code>irParmAddress</code>	DWord	Ptr to DEVICE=Line	BPB Array (Blk only)
<code>irDriveNumber</code>	Byte	1st disk num available	
<code>irMessageflag</code>	Word		(DOS 5) DOS displays error msg on load failure

01 Media Check Block Drivers only

		Input	Output
<code>mrLength</code>	Byte	Length of structure	
<code>mrUnit</code>	Byte	Disk being addressed	
<code>mrFunction</code>	Byte	1	
<code>mrStatus</code>	Word		Returned status
<code>mrReserved</code>	8 Bytes		
<code>mrMediaID</code>	Byte	Media DOS assumes for drive	
<code>mrReturn</code>	Byte		Disk Changed status
<code>mrVolumeID</code>	WWord		Ptr to Disk Volume ID

02 Build BPB Block Drivers only

		Input	Output
<code>bbrLength</code>	Byte	Length of structure	
<code>bbrUnit</code>	Byte	Disk being addressed	
<code>bbrFunction</code>	Byte	2	
<code>bbrStatus</code>	Word		Returned status
<code>bbrReserved</code>	8 Bytes		
<code>bbrMediaID</code>	Byte	Media descriptor	
<code>bbrFATSector</code>	DWord	Ptr to 1st FAT sector	
<code>bbrBPBAddress</code>	DWord		Ptr to BPB

04 Read Character and Block drivers

		Input	Output
<code>rwrLength</code>	Byte	Length of structure	
<code>rwrUnit</code>	Byte	Disk being addressed	
<code>rwrFunction</code>	Byte	4	
<code>rwrStatus</code>	Word		Returned status
<code>irwrReserved</code>	8 Bytes		
<code>rwrMediaID</code>	Byte	Media descriptor (Blk only)	
<code>rwrBuffer</code>	DWord	Ptr to data buffer	
<code>rwrBytesSec</code>	Word	Sectors (Bytes) to read	Actual sector (Bytes) read
<code>rwrStartSec</code>	Word	Starting sector number (Blk only)	
<code>rwrVolumeID</code>	DWord		Ptr to volume ID string
<code>rwrhugeStartSec</code>	DWord	Start sec for >32 MB drive (Blk only)	

08 Write Character and Block drivers

		Input	Output
<code>rwrLength</code>	Byte	Length of structure	
<code>rwrUnit</code>	Byte	Disk being addressed	

Figure 3: Device drivers provide DOS with all of the functions described above.

Device Driver Functions

2 of 2

08 Write Character and Block drivers (continued)

		Input	Output
rwFunction	Byte	8	
rwStatus	Word		Returned status
irwReserved	8 Bytes		
rwMediaID	Byte	Media descriptor (Blk only)	
rwBuffer	DWord	Ptr to data buffer	
rwBytesSec	Word	Sectors/Bytes to write	Actual Sectors/Bytes written
rwStartSec	Word	Starting sector number (Blk only)	
rwVolumeID	DWord		Ptr to volume ID (Blk only)
rwHugeStartSec	DWord	Start sec for >32 Meg drive (Blk only)	

09 Write with Verify Character and Block drivers

		Input	Output
rwLength	Byte	Length of structure	
rwUnit	Byte	Disk being addressed	
rwFunction	Byte	9	
rwStatus	Word		Returned status
irwReserved	8 Bytes		
rwMediaID	Byte	Media descriptor (Blk only)	
rwBuffer	DWord	Ptr to data buffer	
rwBytesSec	Word	Sectors/Bytes to write	Actual Sectors/Bytes written
rwStartSec	Word	Starting sector number (Blk only)	
rwVolumeID	DWord		Ptr to volume ID (Blk only)
rwHugeStartSec	DWord	Start sec for >32 MB drive (Blk only)	

0D Open device Character and Block drivers

		Input	Output
ocrLength	Byte	Length of structure	
ocrUnit	Byte		
ocrFunction	Byte	0Dh	
ocrStatus	Word		Returned status
ocrReserved	8 Bytes		

0E Close device Character and Block drivers

		Input	Output
ocrLength	Byte	Length of structure	
ocrUnit	Byte		
ocrFunction	Byte	0Eh	
ocrStatus	Word		Returned status
ocrReserved	8 Bytes		

0F Removable media check Block Drivers only

		Input	Output
rmrLength	Byte		Length of structure
rmrUnit	Byte		
rmrFunction	Byte	0Fh	
rmrStatus	Word		Returned status
rmrReserved	8 Bytes		

been changed. The function returns a double-word pointer to the BPB in the bbrBPBAddress field of the request packet. For drivers that have set the non-

IBM format bit (bit 13) in the attribute word to 0, DOS passes a pointer to a buffer that contains the first sector of the FAT (file allocation table) for the disk.

The driver can use the FAT sector to determine the media ID byte, which is encoded in the first byte of the FAT.

IOCTL (I/O Control) Read (function 03) lets applications read control information from the device. The IOCTL read function is used both by character and block drivers, but only if bit 14 of the device attribute word is set. The information is used for device control rather than for reading data from the device. For example, a character device such as a printer driver may use the control information to set the proper code page to use. A block driver may use the information to set caching parameters for the device. (See the discussion of the Generic IOCTL function below for specific examples of how DOS uses the IOCTL functions.)

DOS uses the Read function (04) to obtain information from the device. Both character and block drivers use this function. For character drivers, DOS passes the number of bytes to be read in the rwBytesSec field and puts a long pointer to a buffer in the rwBuffer field. The character driver then reads the data from the device and places it in the specified buffer.

When reading from a block device, on the other hand, DOS specifies the logical sector to read by passing the starting sector number in the rwStartSec field. For DOS disks, a sector is the lowest addressable unit on the drive. For most DOS disks, the sector size is 512 bytes. This means that to modify just a single byte on a disk, DOS must read an entire sector, modify the one byte, and then write the entire 512-byte sector back to the disk.

With block devices, the rwBytesSec field contains the number of sectors to read instead of a byte count. The driver returns the number of sectors actually read in this same field. The driver should also return a pointer to the Volume ID string in the rwVolumeID field.

The rwMediaID field contains the media descriptor of the disk that DOS assumes is currently in the drive. This descriptor is a hex number that defines the disk type. The block driver should confirm that the media ID is correct by comparing the ID passed by DOS with that of the disk actually in the drive. If these do not match, the driver should return an

Invalid Disk Change error code in the status word.

Since DOS 4.0 (actually, since Compaq DOS 3.31), DOS has been able to read disks larger than the once-sacrosanct 32MB limit. For block device drivers this means that DOS must pass a starting sector field larger than the 65,535 limit imposed by the 2-byte size of the `rwrStartSec` field. If the starting sector is larger than 65,535, DOS places 0FFFFh in `rwrStartSec` and puts the actual starting sector number in the double-word `rwrHugeStartSec` field. Block drivers that can handle sector numbers larger than 65,535 must also set bit 1 in the device attribute word.

Nondestructive Read (function 05) lets DOS read a byte of data from a character device without removing it from the data stream. This allows DOS to peek at the next character coming from the device even if it is not ready to use that character. All this function must do is return the next character in the `nrrChar` field of the request packet. Block drivers simply set the Done bit in the status field and return.

For a character-mode device, DOS uses the Get Input Status function (06) to determine whether any characters are available. If none are waiting, the driver should set the Busy and Done bits and return. If characters are available, the driver clears the Busy bit, sets the Done bit, and returns. Block devices simply set the Done bit and return.

The Input Flush function (07) lets DOS clear the input stream of a character device. Any characters waiting in the character device are wiped out when this call is made. The function has no effect on block drivers.

The Write function allows DOS to write data to block drivers and character devices. For character drivers, the `rwrBuffer` field contains a pointer to the data to be written to the device. The `rwrBytesSec` field contains the number of bytes to write to the device.

As with the Read function, block drivers interpret the fields that DOS passes differently. The `rwrBuffer` field still contains a pointer to the data that is to be written, but the `rwrBytesSec` field in this case contains the number of sectors, not the number of bytes to be written. The `rwrStartSec` field contains the starting

sector for the data. If this number is larger than 65,535, the `rwrStartSec` field is loaded with the number 0FFFFh and the starting sector number is placed into the `rwrHugeStartSec` field.

The Write with Verify function is similar to the Write function except that the data is automatically read back from the device to the driver for verification. If the data read back does not match the data written, the driver should set the Error bit in the status word and return an error code in the low byte of the status word.

The GetOutput Status function (0A) is used only for character drivers. It allows DOS to determine whether any data is in the device driver output buffer. Any data here has been written to the driver by DOS but has not yet been written to the actual device. As with the Input Status function, status is returned to DOS via the Busy bit. If there is data in the output buffer, the Busy bit should be set when the function returns; otherwise the bit should be cleared.

The Output Flush function (0B) is used to clear the device driver's output buffers. This function is the complement to the Input Flush function (07).

The IOCTL (I/O Control) Write function (0C) lets DOS write control information to the device. The `irwrData` field contains a pointer to the buffer containing the control data. The `irwrBytes` field initially holds the number of bytes to be written. On return, this field should contain the number of bytes actually written to the device. As with the IOCTL Read function, this function is called only if bit 14 in the device attribute word is set.

The Open Device function informs a device that DOS has opened either the character device or a file on the block device. Drivers can use this call to increment a file/device-open count to manage internal buffers. This function is called only if bit 11 in the device attribute word is set.

The Close Device function is the complement of the Open Device call. DOS calls this function when it closes either a character device or a file on a block device. Again, this call can be used to decrement a device/file-use count to manage the device. As with the Open Device call, this function is called only if bit 11 in the device attribute word is set.

DOS calls the Removable Media

Check function to determine whether a block device contains a removable medium. The Busy bit and the Done Bit in the status word must be set if the disk is removable. If the disk is not removable, the Busy bit should be cleared and the Done bit set. This function is designed for block drivers only; character drivers should just set the Done bit and return.

The Output Until Busy function (10) is used to transfer as much data as possible to a character device. When the device indicates that it is full, the function returns immediately without waiting to transfer any remaining bytes. This function differs from the Write function in that the Write function will wait until all the data has been transferred to the device. For example, by calling the Output Until Busy function, DOS can write data to fill a printer's internal buffer without waiting to write all of the data. Please note that this function can be used on any type of device that contains hardware buffering.

As with the Write function, DOS passes a pointer to the data in the `orBuffer` field. The number of bytes to attempt to write is placed in the `orBytes` field. When the function returns, the `orBytes` field should be set to the number of bytes that are actually written. Note that this function is called only if bit 13 in the device attribute word is set.

Generic IOCTL Minor Codes

For Serial, Console, and Printer categories:

Code	Function
45h	Set Iteration Count
4Ah	Select Code Page
4Ch	Start Code Page Prepare
4Dh	End Code Page Prepare
65h	Get Iteration Count
6Ah	Query Selected Code Page
6Bh	Query Code Page Prepare List

For Disk category:

Code	Function
40h	Set Device Parameters
41h	Write Track on Logical Drive
42h	Format Track on Logical Drive
46h	Set Media ID
60h	Get Device Parameters
62h	Verify Track on Logical Drive
66h	Get Media ID
68h	Sense Media Type

Figure 4: These Minor function codes are used by the Generic IOCTL for character and block device functions.

DOS uses the Generic IOCTL function (13) to direct the driver to carry out generic IOCTL functions specified in the `giCategory` and `giMinorCode` fields of the request packet. The `giCategory` field specifies the type of device being addressed: 1 indicates a serial device, 2 a Console (display), 5 a Parallel printer, and 8 a Disk. A Driver must check the category to determine whether it supports the device. Drivers may support other categories not listed.

The Minor Code specifies the command to be performed by the driver. The command varies with the category of the device. Figure 4 presents a table of the different Minor Codes for each device category. For the character devices (Serial, Console, and Parallel), the Minor Codes correspond to the function available in DOS Function 440Ch (Generic IOCTL for character devices). For block devices, the Minor Codes correspond to the Generic IOCTL for Block devices (Int 21h Function 440Dh). This function is called only if bit 13 in the device attribute word is set.

The Get Logical Drive function (17) returns the active drive number for the specified drive. DOS can assign more than one drive number to a physical drive. For example, floppy drive A: can be addressed as the B: drive in single-floppy systems. This function allows DOS to query the currently active drive number to determine if the driver is currently set to access the A: or B: drive.

DOS calls this function with the `idrUnit` field containing the drive number to check. The same `idrUnit` field should be modified to return the drive number currently active for that drive. The function is valid only for block devices, and then only if bit 6 in the device attribute word is set.

The Set Logical Device function (18) lets DOS assign a block device to a different drive letter. The `ldrUnit` field contains the new logical device number for the drive. As with the Get Logical Device function, this function will be called only if bit 6 in the device attribute word is set. The Set Logical Device function is valid only for block drivers.

The IOCTL Query function (19) allows DOS to determine which generic IOCTL function the driver supports. The function is called with a category and a

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minor code, which are specified in the `giCategory` and `giMinorCode` fields. If the driver does not support the IOCTL function, the Error and Done bits should be set in the status word. An Unknown Function (03) error code should be returned in the lower byte of the status word. If the driver supports the function queried, the driver should simply set the Done bit and return. This function is called only if bit 7 in the device attribute word is set.

HOW REDD WORKS Having reviewed the basics of DOS device drivers, I'll now briefly discuss the inner workings of REDD.

As a simple RAM disk, REDD requires a block device driver. In terms of driver functions, REDD implements the bare minimum: Init, Media Check, Build BPB, Read, Write, Write with Verify, Open Device, Close Device, and Removable Media. (Actually, Open and Close device are not required for block drivers,

but the code for these functions is so simple that I included it.) All in all, the code needed to implement the RAM disk portion of REDD totals less than 2K.

The REDD RAM disk is organized like most DOS disks: It has a boot sector, a file allocation table (FAT), a root directory, and data sectors. Although the format of the disk appears standard to DOS, REDD is designed to use far less RAM than a conventional RAM disk does. In order to do this, only the relevant portions of the major structures (boot sector, FAT, root directory) are actually implemented.

Thus, for example, most of the normal 512-byte boot sector houses a boot program that is used only if the disk is used to boot the machine. Since REDD will never be called on to boot up the machine, only the relevant portions of the boot sector are implemented: the initial JMP instruction, the OEM identification field, and the BIOS parameter block.

When DOS reads the boot sector, the important data is returned and the remainder of the sector is padded with zeros. When DOS attempts to write the boot sector, only the necessary data fields are updated. This reduces the 512-byte boot sector to just over 60 bytes. The same technique is also used for the FAT and root directories. The only sectors actually implemented as full 512-byte buffers are the data sectors of the disk. And since the disk is only 2,560 bytes in size, the REDD device driver takes up very little room.

REDD is actually rather more than the simple RAM disk that it appears to be. The differences between REDD and a standard RAM disk are apparent in the code that implements the two special files, SCREEN.OUT and KEYBOARD.IN.

The SCREEN.OUT file is nothing more than a buffer that is mapped to occupy the first few data sectors of the REDD RAM disk. When REDD is initialized, the FAT is modified to allocate the first few data sectors to a file. A root directory entry is then filled in to assign

the name SCREEN.OUT to these data sectors, thus creating the file. The initialization routine also hooks into the BIOS video interrupt (Int 10h).

When a program calls the BIOS video interrupt to display characters on the screen, REDD intercepts the call and copies the relevant data to the data sectors devoted to the SCREEN.OUT file. A pointer is maintained to add the new screen data onto the end of the file. Once the recorded video data becomes larger than the size of the file, the oldest portion of the file is overwritten with the new data. This technique keeps the SCREEN.OUT file filled with the latest screen data. Note that the time and date fields of the SCREEN.OUT entry in the root directory are updated with the current time. This lets you know that the SCREEN.OUT file has been updated without even having to read the file.

When REDD detects that a file with the name KEYBOARD.IN has been copied to the REDD disk, it copies the first few bytes into the machine's BIOS keyboard buffer. Since KEYBOARD.IN

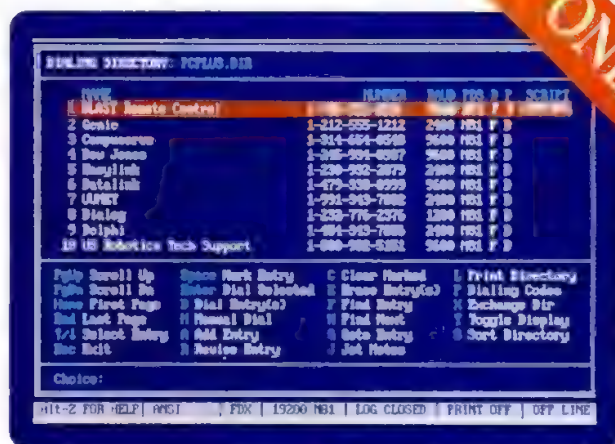
is usually larger than the 15-byte size of that buffer, the file cannot be copied in one step. REDD uses the Timer interrupt (Int 8) to let it copy the contents of the file into the keyboard buffer gradually. Each time the Timer interrupt is called, REDD checks to see whether there is any space in the keyboard buffer. If there is, REDD copies the next few bytes of the file into the buffer. When KEYBOARD.IN has been completely copied into the keyboard buffer, the file is deleted by removing its entry from the root directory and zeroing out the appropriate entries in the FAT table.

REDD implements a feature commonly found on most other networked computers, namely, the ability to execute a program on another machine. DOS-based machines are not the most complex computers available, but their ability to be personally programmed through features such as REDD makes them the most productive. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR TO PC MAGAZINE.



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LAB NOTES

Accessing the Windows API From the DOS Box, Part 2

BY ANDREW SCHULMAN

If you've ever had unwelcome guests attend a party, you may have tried to get rid of them by "forgetting" to refill their drinks or neglecting to introduce them to other guests; actually, doing everything short of kicking them out: "Here's your hat. What's your hurry?"

This is how Microsoft Windows treats DOS programs. It provides these unwelcome guests with a level of service that is just short of insulting. This creates an unfortunate situation for those of us who like Windows but who also have many DOS programs that we need to run. It would be nice if somehow our DOS programs could benefit from running under Windows.

In last issue's Lab Notes we saw that, although Windows generally treats DOS programs like unbidden guests, it does provide at least a few programmer's services that we can use to build a bridge between DOS programs and Windows functionality. More specifically, we saw that the INT 2Fh functions of Windows Enhanced mode provide a way for DOS applications to access the Windows Clipboard.

We used these INT 2Fh functions—OpenClipboard(), GetClipboardData(), SetClipboardData(), CloseClipboard(), and so on—to build two C functions: PutClipString() and GetClipString(). In turn, we used these two functions to build two handy DOS programs—GETCLIP and PUTCLIP—which retrieve or change the contents of the Windows Clipboard.

But as nice as it is to provide DOS programs with a C function that lets them read the Windows Clipboard, we surely want to do more than that. Moreover, if Microsoft were determined to give DOS

programs access to only 10 of the roughly 1,200 Windows API functions, why pick the Clipboard functions instead of more useful ones?

If you could call the WinExec() function from a DOS program, for example, you could run Windows programs from the DOS box. Calling SetWindowText() would allow you to change a window's title bar. And if you were able to call

*By learning to
construct CLIPSERV.C
and CMDCLIP.C, you'll be
able to start giving your
DOS programs access to the
Windows API.*

SendMessage() or PostMessage(), a DOS program could send keystrokes to a Windows application. Microsoft did not provide DOS programs with INT 2Fh versions of WinExec() or SetWindowText() or SendMessage() or PostMessage(), however. So, with nothing but OpenClipboard(), SetClipboardData(), and the like, are we stuck?

No. The INT 2Fh Clipboard functions will suffice. DOS programs can use this handful of functions to gain a limited form of access to the Windows party. True, there's no "Open Sesame" command that will admit DOS programs directly to the party—nothing will change that. But a DOS program running under Windows can use the Clipboard to communicate its requests to a responsive Windows application.

Thus, although you can't run a Windows application from the DOS box, you can ask a suitable Windows application to run one for you. You can't change the title bar, but again, you can ask a Windows application to do it on your behalf. What you need is a *surrogate program*: a Windows application whose sole responsibility is to do things for your DOS programs that they aren't allowed to do for themselves. I'll show you how to write such a program—a Windows application that acts as a *server* for requests that come from DOS applications—using the Clipboard as the place where these messages get delivered.

Before I proceed, however, it's worth mentioning that there are other possible approaches to the problem of giving DOS applications access to Windows. For example, Doug Boling's WINSTART utility (PC Magazine, June 30, 1992), uses a DOS TSR that runs *before* Windows to let you run Windows programs from within a DOS box.

Alternatively, Microsoft C/C++ 7.0 includes a Windows virtual device driver (VMB.386) that provides a message buffer that is shared between a DOS program (WX) and a Windows program (WXSRRV, the Windows Spawn Server). With this approach, however, you need three executables just to be able to type the name of a Windows program in the DOS box and have it do something other than print "This program requires Microsoft Windows"!

My approach differs from those of WINSTART and WXSRRV not only in that it uses the Clipboard as the message buffer, but also in that it provides DOS programs with general-purpose access to the Windows API, not just to WinExec(). I'm going to create two programs: CLIP-

SERV, the Windows server, and CMDCLIP, the DOS client. By the time we're done, CLIPSERV will provide CMDCLIP with what in Windows is called run-time dynamic linking. Also, the ability to call the WinExec() function from the DOS box will just fall out from this as one example of a general-purpose capability. Programs that were mentioned in Part 1 of this discussion (in the August 1992 issue) are available on PC MagNet, archived as CLIP1.ZIP, CLIPSERV, and CMDCLIP. The related files introduced in this second part can be downloaded as CLIP2.ZIP.

Let's start with the PUTCLIP program from last issue. PUTCLIP is a DOS program that puts text on the Windows Clipboard. For example,

```
C:\PCMAG>putclip "hello Windows!"
```

puts the string "hello Windows!" on the Windows Clipboard. You can see this string appear if you run the Windows Clipboard program (CLIPBRD.EXE), which displays the Clipboard's current contents.

Now let's put a different string in the Clipboard. Figure 1 shows the new string—RUN NOTEPAD.EXE—which looks like a request. But no matter how much that string *looks* like a request, there's no reason to believe that it will be *acted upon* as a request. As Glendower, in Shakespeare's *Henry IV, Part I*, declared: "I can call spirits from the vasty deep." To which Hotspur properly retorted: "Why, so can I, or so can any man; But will they come when you do call for them?"

In other words, the Clipboard Viewer

(CLIPBRD.EXE) that comes with Windows has no way to treat a string as a command line. Fortunately, although the Viewer is frequently confused with the Clipboard itself, in reality the Viewer is just another application. Moreover, there is provision within Windows to replace it or supplement it with alternate Clipboard Viewers. In fact, instead of displaying the Clipboard's current contents, an alternative Viewer could actually *do* something, such as carry out the request that appears in the Clipboard. With such a Windows program hanging off the Clipboard, DOS programs can indeed call Windows spirits from the vasty deep!

*Instead of displaying the
Clipboard's current
contents, an alternative
Viewer could actually do
something—such as carry
out the request that appears
in the Clipboard.*

HANGING OFF THE CLIPBOARD Our first goal, then, is to write a Windows program that waits for DOS programs to put requests into the Clipboard. This program, CLIPSERV, needs to know: first, when the Clipboard contents have changed; second, whether they were changed by a DOS program; and third, whether the DOS program is issuing a request rather than simply engaging in a normal cut-and-paste operation.

Taken individually, each of these problems is easy to solve. CLIPSERV can find out that the Clipboard contents have changed not by checking the Clipboard every second, but by doing exactly what Windows programs always do: waiting until a message arrives. Windows lets a program know that the Clipboard contents have changed by sending it a WM_DRAWCLIPBOARD message. The message gets its name

from the fact that Windows expects the recipient to display the entire Clipboard contents; however, it really means only that there has been a change in the Clipboard contents.

In order to receive the WM_DRAWCLIPBOARD message, CLIPSERV must use the SetClipboardViewer() function to set itself up as a Clipboard Viewer. Since there can be more than one program hanging off of the Windows Clipboard at a given time, each program in the Clipboard Viewer chain is expected to help keep the chain intact. Therefore, alternative viewers must also handle WM_CHANGECHAIN messages and pass on every WM_DRAWCLIPBOARD message.

Inside the part of the program that handles the WM_DRAWCLIPBOARD messages, CLIPSERV can string together three Windows function calls to figure out whether the Clipboard contents were changed by a DOS program:

- GetClipboardOwner() returns the window handle (HWND) of the last program to call SetClipboardData().
- GetWindowTask() takes an HWND and returns a corresponding task handle (HTASK); that is, an identifier for an instance of a program.
- IsWinOldApTask() takes an HTASK and determines whether the task belongs to the Windows WINOLDAP module; that is, whether it is a DOS ("old") application. This function is undocumented but reliable. Indeed, Windows' own TASKMAN uses it. (For more details about IsWinOldApTask(), see *Undocumented Windows*, a book I recently coauthored.)

So far, CLIPSERV knows whenever a program in the DOS box has put something in the Clipboard. Now CLIPSERV needs a way to distinguish between command strings and normal cut-and-paste text. This is the problem with hijacking the Clipboard Viewer as an interprocess-communications mechanism.

In Windows programming, the RegisterClipboardFormat() function would be used to enable such private conversations. In this case, however, there's a DOS program on one end of the conversation; and unfortunately, RegisterClipboardFormat() is not one of the Windows API calls that Microsoft supplied with an INT 2Fh interface. I mentioned earlier

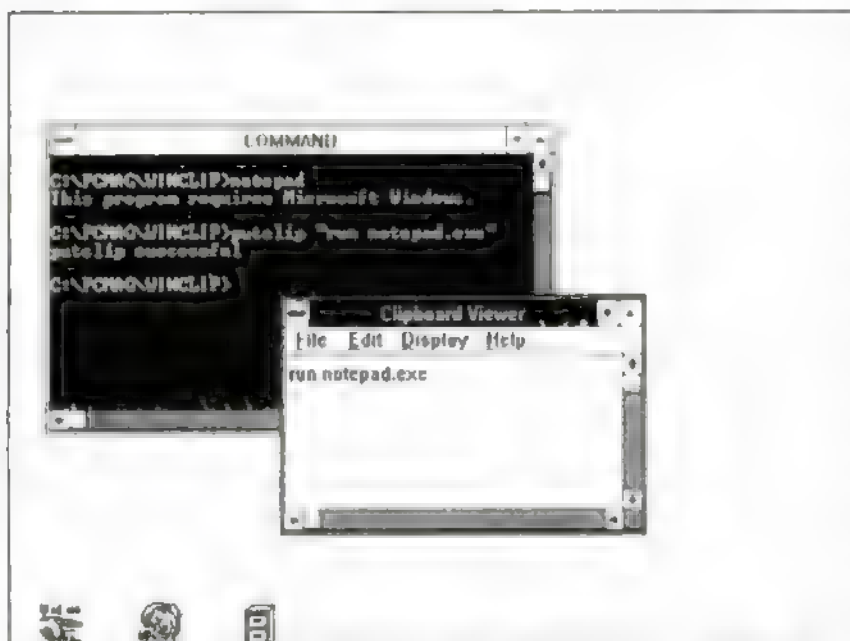


Figure 1: PUTCLIP puts a string into the Clipboard, and CLIPBRD displays it.

that CLIPSERV would give DOS programs general-purpose access to the Windows API and, in fact, a DOS program *will* be able to call RegisterClipboardFormat()—as soon we can set up a reliable connection to CLIPSERV!

It's one of those chicken-and-egg-type problems. The solution, at least for

the time being, is to have the DOS program put its requests in the Clipboard using a standard CF_TEXT format. Although CF_TEXT (the CF simply stands for Clipboard Format) is also used by WINOLDAP *whenever* you copy text from a DOS box to the Clipboard, we can establish a convention of our own that

will identify the string as a request to be carried out rather than ordinary, static text.

Since the DOS client that we will eventually be building will be called CMDCLIP (CMD is just an abbreviation for command), I arbitrarily ruled that any text placed in the Clipboard by a DOS box that started with the string "CMDCLIP" was to be interpreted as a command to be handled by CLIPSERV. Call it a kludge if you like, but it works fine in practice.

Conceptually, the key part of CLIPSERV looks like the semi-pseudocode shown in Figure 2.

HANDLING MESSAGES Like any Windows program, CLIPSERV must handle messages. As an ostensible Clipboard "viewer," CLIPSERV needs to be able to handle WM_DRAWCLIPBOARD, WM_CHANGECHAIN, and WM_DESTROY messages, at the very least. On the other hand, CLIPSERV has no need for a user interface: There's nothing for it to display in a window (unless you want to provide a debugging output), and it has no use for user input. Everything it needs to know it learns from the Clipboard.

This presents an odd problem. CLIPSERV is message-driven, yet it has no user interface. But in Windows programming, you never see message handling without a window. The function that handles messages is invariably called a WndProc, and the things that users perceive as windows are really just the user-interfaces for message handling. Yet there doesn't seem to be a good reason why the two concepts—message handling and user interface—should be linked in this way.

In fact, the message queues inside Windows *don't* have anything to do with windows. From a Windows programmer's perspective, you can call GetMessage() without having a window handle (HWND). All GetMessage() needs to work is a Task Queue structure, which is allocated automatically for your task even before its WinMain() function is called. What does require an HWND is DispatchMessage(), but this function is not essential to message handling.

In other words, it is possible to write windowless Windows programs that do background processing. A good example

CLIPSERV PSEUDOCODE

Partial Listing

```
switch WM_DRAWCLIPBOARD:
  if (IsWinOldApTask(GetWindowTask(GetClipboardOwner())))
  {
    char *s = get_clipboard_string();
    if (strncmp(s, "CMDCLIP", 7) == 0)
      do_request(&s[8]);
  }
```



Figure 2: In this conceptual overview of the key component of CLIPSERV, strings beginning with CMDCLIP are interpreted as commands.

GETMSG.C

Complete Listing

```
/* GETMSG.C - GetMessage with no window */

#include "windows.h"

int PASCAL WinMain(HANDLE hInst, HANDLE hPrevInst,
  LPSTR lpCmdLine, int nCmdShow)
{
  WORD hTimer;
  MSG msg;
  int i = 0;

  hTimer = SetTimer(0, 1, 1000, NULL);
  while (GetMessage(&msg, NULL, 0, 0))
    if (msg.message == WM_TIMER)
    {
      MessageBeep(0);
      if (++i == 5)
        break;
    }
  KillTimer(0, hTimer);
  return 0;
}
```



Figure 3: This small Windows program illustrates windowless message handling.

CLIPSERV

Partial Listing

```
WinMain()
{
  hwnd = objwnd(hPrevInstance, hInstance, "clipserv");
  hwndNextViewer = SetClipboardView(hwnd);
  on(WM_DRAWCLIPBOARD, do_checkclipboard);
  on(WM_CHANGECHAIN, do_changechain);
  on(WM_DESTROY, do_destroy);
  on(WM_CLIPCMD, do_clipcmd); // user-defined message
  return mainloop(); // go!
}

long do_checkclipboard(HWND hwnd, WORD msg, WORD wparam, LONG lparam)
{
  // heart of CLIPSERV: handle WM_DRAWCLIPBOARD here
}

long do_changechain(HWND hwnd, WORD msg, WORD wparam, LONG lparam)
{
  // handle WM_CHANGECHAIN here
}
```



Figure 4: This code fragment shows the basic structure of CLIPSERV using the OBJWND.C library.

is shown in Figure 3. The program GETMSG installs a timer that will go off once per second. It calls GetMessage(), yet it has no window. Each time it receives a WM_TIMER message, it beeps; after 5 seconds, it exits.

We could use this scheme in the CLIPSERV program, watching for WM_DRAWCLIPBOARD events instead of WM_TIMER events. But while not required for the basic message handling, CLIPSERV will need an HWND for other operations, such as Clipboard access.

What CLIPSERV really needs is something such as OS/2 Presentation Manager's *object window*. This is an entity that can be used as a target for messages and can handle messages, but is not visible and accepts no user input. Fortunately, it is possible to emulate OS/2 object windows under Microsoft Windows.

To handle the messages, of course, you must write what's called a *window procedure*. The term window here is really a misnomer, however: What is called a window procedure is really just a message handler. The window to which it cor-

responds can be invisible. It's not really a user-interface object but a pure message-handling object. The necessary RegisterClass() and CreateWindow() calls can be packaged into a function that creates something like the OS/2 object window.

At the same time, there are better ways to set up message handling than with the C switch/case statements usually used in Windows programs. These switch/case statements lead to single functions that go on for pages and pages, with no attempt to break the problem

OBJWND.C

Complete Listing

```
/* OBJWND.C -- "object windows" from WMHANDLER */

#include "windows.h"
#include "objwnd.h"

static WMHANDLER wnhandler[WM_USER] = {0};

#define MAX_EXTRA 32

typedef struct {
    WORD message;
    WMHANDLER handler;
} EXTRAHANDLER;

static EXTRAHANDLER extrahandler[MAX_EXTRA] = {0};
static int num_extra = 0;

static int isextramsq(WORD message)
{
    EXTRAHANDLER *pex;
    int i;
    for (i=0, pex=extrahandler; i<MAX_EXTRA; i++, pex++)
        if (pex->message == message)
            return i;
    return -1;
}

static BOOL did_init = FALSE;
void objwnd_init(void)
{
    EXTRAHANDLER *pex;
    WMHANDLER *pwm;
    int i;
    for (i=0, pwm=wnhandler; i < WM_USER; i++, pwm++)
        *pwm = defwmhandler;
    for (i=0, pex=extrahandler; i < MAX_EXTRA; i++, pex++)
    {
        pex->message = 0;
        pex->handler = defwmhandler;
    }
    did_init = TRUE;
}

long FAR PASCAL _export WndProc(HWND hwnd, WORD message,
    WORD wParam, LONG lParam)
{
    int iExtraMsg;

    if (message < WM_USER)
        return (*wnhandler[message])(hwnd, message, wParam, lParam);
    else if ((iExtraMsg = isextramsq(message)) != -1)
        return (*extrahandler[iExtraMsg].handler)(hwnd,
            message, wParam, lParam);
    else
        return DefWindowProc(hwnd, message, wParam, lParam);
}

static long defwmhandler(HWND hwnd, WORD message, WORD wParam, LONG lParam)
{
    return DefWindowProc(hwnd, message, wParam, lParam);
}

WMHANDLER on(unsigned message, WMHANDLER f)
{
    WMHANDLER oldf;
    int iExtraMsg;

    if (! did_init)
        objwnd_init();

    if (message < WM_USER)
    {
        oldf = wnhandler[message];
        wnhandler[message] = f ? f : defwmhandler;
        return (oldf ? oldf : defwmhandler);
    }
    else if ((iExtraMsg = isextramsq(message)) != -1)
    {
        oldf = extrahandler[iExtraMsg].handler;
        extrahandler[iExtraMsg].handler = f ? f : defwmhandler;
        return (oldf ? oldf : defwmhandler);
    }
    else if (num_extra < MAX_EXTRA)
    {
        extrahandler[num_extra].message = message;
        extrahandler[num_extra].handler = f;
        num_extra++;
        return defwmhandler;
    }
    else
        return -1; // couldn't set!
}

HWND objwnd(HANDLE hPrevInst, HANDLE hInst, char *name)
{
    static HWND hwnd = 0;

    if (hwnd)
        return hwnd;

    if (! did_init)
        objwnd_init();

    if (! hPrevInst)
    {
        WNDCLASS wndclass;
        memset(&wndclass, 0, sizeof(wndclass));
        wndclass.lpfnWndProc = WndProc;
        wndclass.hInstance = hInst;
        wndclass.hbrBackground = GetStockObject(WHITE_BRUSH);
        wndclass.lpszClassName = "OBJECTWND";
        if (! RegisterClass(&wndclass))
            return 0;
    }

    hwnd = CreateWindow("OBJECTWND", name,
        WS_OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT, 0, 0,
        NULL, NULL, hInst, NULL);
    return hwnd;
}

void yield(void)
{
    MSG msg;
    if (GetMessage(&msg, NULL, 0, 0))
    {
        TranslateMessage(&msg);
        DispatchMessage(&msg);
    }
}

int mainloop(void)
{
    MSG msg;
    while (GetMessage(&msg, NULL, 0, 0))
    {
        TranslateMessage(&msg);
        DispatchMessage(&msg);
    }
    return msg.wParam;
}
```



Figure 5: OBJWND.C provides on-event message handling and creates the equivalent of the OS/2 Presentation Manager's invisible object windows.

into subroutines. The source code for the DefWindowProc() function that comes with the Windows SDK (Software Development Kit), for example, is 14 printed pages long! The natural tendency of switch/case statements is to produce such multipage functions.

Probably the best model for message-driven programming is the humble

ON event GOSUB subroutine

statement in BASIC. Interestingly, Microsoft has finally (after seven years!) acknowledged this rather obvious fact by introducing OnXXX "message crackers" in the Windows 3.1 SDK, and OnXXX handler functions in C/C++ 7.0. Alas,

Microsoft hasn't bothered to use these to rewrite that 14-page DefWindowProc().

Fortunately, on-event programming is simple to implement for yourself; all it requires is breaking out of the old switch/case mindset of the SDK. For about two years I have been using on-event functions in every Windows program I write, thanks to a small set of functions called WMHANDLER that David Maxey of Lotus Development Corp. and I wrote together.

Seeing the need in CLIPSERV for essentially windowless message-handling (and having WMHANDLER as a base), I came up with a small C library called OBJWND. Using OBJWND, the basic structure of CLIPSERV looks like the

code fragment that is shown in Figure 4.

Instead of using a single, massive switch statement, CLIPSERV makes use of a collection of small functions, each of which handles a single message. To make this possible, OBJWND maintains an array of function pointers, called `wmhandler[]`. The array is indexed by Windows WM_message numbers such as 0x308 for WM_DRAWCLIPBOARD or 0x0002 for WM_DESTROY. For the most part, the `on(msg, func)` function just sets `wmhandler[msg] = func`. OBJWND has a built-in window procedure, `WndProc()`, whose sole job on receipt of a message is to call the function at `wmhandler[message]`. Whatever a given program does, this `WndProc()` function

CLIPSRV1.C

Complete Listing

```
/* CLIPSRV1.C -- first version of clipboard server */

#include <stdlib.h>
#include <string.h>
#include <malloc.h>
#include <windows.h>
#include <objwnd.h>

#define WM_CLIPCHD (WM_USER+1)

HWND this_hwnd, hwndNextViewer;

void do_run(HWND hwnd, char far *cmd)
{
    WinExec(cmd, SW_NORMAL);
}

void do_settitle(HWND hwnd, char far *cmd)
{
    SendMessage(hwnd, WM_SETTEXT, 0, cmd);
}

#pragma argsused
long clipcmd(HWND hwnd, unsigned msg, WORD wparam, LONG lparam)
{
    HWND owner = wparam; // HWND of clipboard owner
    char far *a = (char far *) lparam;
    char far *cmd = _fstrook(a, '\t');
    char far *param = a + _fstrlen(cmd) + 1;
    if (_fstrcmp(cmd, "RUN") == 0)
        do_run(owner, param);
    else if (_fstrcmp(cmd, "SETTITLE") == 0)
        do_settitle(owner, param);
    else if (_fstrcmp(cmd, "EXIT") == 0)
        SendMessage(hwnd, WM_DESTROY, 0, 0);
    _free((char far *) lparam);
    return 0;
}

long check_clipboard(HWND hwnd, unsigned msg, WORD wparam, LONG lparam)
{
    extern BOOL FAR PASCAL IsWinOldApTask(HANDLE); /* undocumented */
    char far *fp = 0;
    HWND owner;

    if (hwndNextViewer)
        SendMessage(hwndNextViewer, msg, wparam, lparam);

    /* only process CMDCLIP requests from OLDAPS */
    owner = GetClipboardOwner();
    if (IsWinOldApTask(GetWindowTask(owner)))
    {
        HANDLE hGMem;
        if (!OpenClipboard(hwnd))
            return 0;
        if (hGMem = GetClipboardData(CF_TEXT))
        {
            LPSTR lp = GlobalLock(hGMem);
            if (_fstrcmp(lp, "CMDCLIP ", 8) == 0)
            {
                int: len = _fstrlen(lp);
                if ((lp[len-1] == '\n') || (lp[len-1] == '\r'))
                    lp[len-1] = '\0'; // remove CRLF
                if ((fp = _fmalloc(len+1)) != 0)
                {
                    char far *fp1 = fp;
                    char far *fp2 = lp+8; // remove "CMDCLIP "
                    while (*fp1++ = *fp2++)
                        ;
                }
                else
                    ; /* insufficient memory */
                GlobalUnlock(hGMem);
                CloseClipboard();
            }
            // don't send message until clipboard closed
            if (fp)
                SendMessage(hwnd, WM_CLIPCHD, owner, fp);
            return 0;
        }
    }

    long changechain(HWND hwnd, unsigned msg, WORD wparam, LONG lparam)
    {
        /* maintain linked list of clipboard viewers */
        if (wparam == hwndNextViewer)
            hwndNextViewer = LOWORD(lparam);
        else if (hwndNextViewer)
            SendMessage(hwndNextViewer, msg, wparam, lparam);
        return 0;
    }

    pragma argsused
    long destroy(HWND hwnd, unsigned msg, WORD wparam, LONG lparam)
    {
        ChangeClipboardChain(this_hwnd, hwndNextViewer);
        PostQuitMessage(0);
        return 0;
    }

    pragma argsused
    int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
        LPSTR lpCmdLine, int nCmdShow)
    {
        if (hPrevInstance)
        {
            MessageBox(NULL, "Already installed", "CLIPSERV", MB_OK);
            return 1; // only one instance allowed
        }

        this_hwnd = objwnd(hPrevInstance, hInstance, "clipserv");
        hwndNextViewer = SetClipboardViewer(this_hwnd);

        on(WM_CHANGECHAIN, changechain);
        on(WM_DRAWCLIPBOARD, check_clipboard);
        on(WM_DESTROY, destroy);
        on(WM_CLIPCHD, clipcmd); /* user-defined message */

        return mainloop(); /* go resident */
    }
}
```



Figure 6: CLIPSERV.C turns strings sent from a DOS program into Windows API calls.

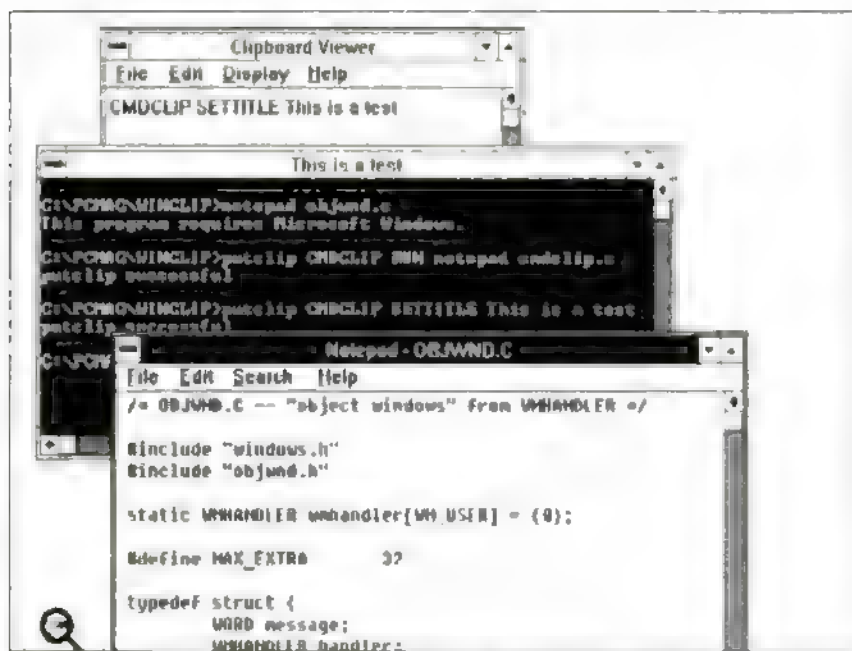


Figure 7: In this screen shot, NOTEPAD is being run from the DOS box, with help from the (invisible) CLIPSRV1.

never changes. The program's message-handling behavior is entirely set with calls to the `on()` function.

OBJWIND.C is shown in Figure 5. You may be interested in comparing my method with that used by Ray Duncan in his Power Programming column (*PC Magazine*, May 26, 1992). Ray uses a static table-driven approach to message handling rather than the `on()` function call provided by OBJWIND. The important point to note, however, is that neither of us uses a switch statement to handle messages. There is no reason why you should, either, unless you can hold the entire 14-page subroutine in your head.

Some of the object-oriented application frameworks for Windows, such as Borland's Object Windows Library (OWL), also get rid of the huge switch statement, replacing it with a collection of functions that each handle a single message. OBJWIND.C shows one way such a scheme can be implemented. It's also worth noting that getting rid of the switch statement does not require an object-oriented language or an application framework, just a bit of common sense.

TURNING STRINGS INTO COMMANDS
With OBJWIND.C in hand, we can proceed to write our alternative Clipboard server, CLIPSERV, which will turn a string like

```
CMDCLIP WINEXEC notepad 1
```

into the live request

```
WinExec("notepad", 1)
```

Before tackling this full-blown version,

however, let's experiment a bit with a limited version so that we aren't overwhelmed and distracted by the additional code to handle runtime dynamic linking.

As shown in Figure 6, CLIPSRV1.C handles only three different requests: RUN, SETTITLE, and EXIT. As the code shows, each of these requests turns into a simple Windows API call that CLIPSRV1 is ready to carry out at a DOS program's behest:

- If CLIPSRV1 is running and a DOS program such as PUTCLIP puts the string

```
CMDCLIP RUN notepad.exe
```

into the Clipboard, it will effectively be as if the DOS program had called

```
WinExec("notepad.exe", SW_NORMAL)
```

- Likewise, the string

```
CMDCLIP SETTITLE This is a test
```

turns into

```
SendMessage(self, WM_SETTEXT, 0,
    "This is a test")
```

where *self* is the DOS box's own window handle.

- Finally, CMDCLIP EXIT causes CLIPSRV1 to send itself a WM_DESTROY message. Since CLIPSRV1 has no user interface, we will need a way to remove the program from memory, or CLIPSRV1 would act like a DOS TSR without an uninstall switch!

CLIPSRV1 does not care how you get any of these strings into the Clipboard, as long as they come from a DOS box. The

DO_RUN() AND PUT_CLIP_STR()

Complete Listing

```
void do_run(HWND hwnd, char far *cmd)
{
    char buf[128];
    wsprintf(buf, "CLIPREPLY RUN %04X", WinExec(cmd, SW_NORMAL));
    put_clip_str(hwnd, buf);
}

WORD put_clip_str(HWND hwnd, char far *s)
{
    WORD ret;
    HANDLE h;
    if (! (h = GlobalAlloc(GMEM_MOVEABLE, _fstrlen(s)+1)))
        return 0; /* insufficient memory */
    while (! OpenClipboard(hwnd))
        yield(); /* see OBJWIND.C */
    EmptyClipboard();
    _fstrcpy(GlobalLock(h), s);
    GlobalUnlock(h);
    if (! (ret = SetClipboardData(CF_TEXT, h)))
        GlobalFree(h);
    CloseClipboard();
    return ret;
}
```

Figure 8: The modified `do_run()` and additional `put_clip_str()` functions allow the CLIPSERV RUN command to put the WinExec return value back in the Clipboard.

GETCLIP.BAT

Complete Listing

```
C:\PCMAG>type cliprun.bat
@echo off
putclip CMDCLIP RUN %1 %2 %3 %4 %5 %6 %7 %8 %9 > nul
getclip

C:\PCMAG>cliprun notepad
CLIPREPLY RUN 121E

C:\PCMAG>cliprun foobar
CLIPREPLY RUN 0002
```

Figure 9: GETCLIP.BAT uses GETCLIP and PUTCLIP in a batch file to get replies to CMDCLIP requests.

CMDCLIP.C

Complete Listing



```

/*
CMDCLIP.C - put commands on Windows clipboard, for CLIPSRV
requires WINCLIP.C
for example (Borland C++): bcc cmdclip.c winclip.c

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PC Magazine * Andrew Schulman (June 1992)
*/

#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include <dos.h>
#include "winclip.h"

/* Save away contents of clipboard before changing it */
static char *save = 0;

/* Before exiting, make sure we restore the saved clip contents */
void cleanup(char *s, int ret)
{
    if (s)
    {
        fputs(s, stderr);
        fputc('\n', stderr);
    }
    if (save)
    {
        PutClipString(save); /* put it back on clipboard */
        FreeClipString(save);
    }
    exit(ret);
}

int Clipserv(void)
{
    char *s;
    int i;
    PutClipString("CMDCLIP INSTCHECK");
    for (i=0; i<5; i++)
    {
        Yield();
        s = GetClipString();
        if (strcmp(s, "CLIPREPLY INSTOK") == 0)
        {
            FreeClipString(s);
            return 1;
        }
        else
            FreeClipString(s);
    }
    /* still here */
    return 0;
}

int main(int argc, char *argv[])
{
    char buf[256], *s;
    char far *cmdtail;
    int len;
    int i;

    fputs("CMDCLIP version 1.0\n", stderr);
    fputs("Copyright (c) 1992 Ziff Davis Communications *\n", stderr);
    fputs("  ** Andrew Schulman\n", stderr);

    if ((argc < 2) ||
        ((argc > 1) && (argv[1][0]!='/') && (argv[1][1]!='?'))) // ?
        cleanup(
            "CMDCLIP puts commands onto the Windows clipboard, to be\n"
            "carried out by CLIPSRV\n"
            "usage: CMDCLIP clipboard-command [optional parameters...]\n"
            "clipboard commands:\n"
            "  * DYLINK [function]
            [args...] - call a Windows API function\n"
            "  * EXIT - tell CLIPSRV to uninstall itself\n"
            "  * RUN [program] [args...] - run a Windows program\n"
            "  * SETTITLE [string] - set the DOS box's title bar", 1);

    /* Make sure we're running under Windows */
    if (! WindowsClipboard())
        cleanup("This program requires Windows Enhanced mode", 1);

    /* Save away current contents of clipboard, except if
    it's just an old CMDCLIP request. NOTE: CMDCLIP just
    saves/restores CF_TEXT; graphics will be bashed.
    save = GetClipString();
    if (strcmp(save, "CMDCLIP ", 8) == 0)
    {
        FreeClipString(save);
        save = 0;
    }

    /* Make sure that CLIPSRV is running: Clipserv() install check
    works by putting a request into the clipboard and seeing if it
    gets changed in the right away. If it doesn't, CLIPSRV must
    not be running. But this test bashes the clipboard, so it
    should only be done AFTER we've saved the clipboard's contents */
    if (! Clipserv())
        cleanup("This program requires Clipserv", 1);

    /* Assemble the command/request for CLIPSRV */
    strcpy(buf, "CMDCLIP ");
    cmdtail = MK_FP(_psp, 0x82);
    len = ((unsigned char far *) MK_FP(_psp, 0x80)) - 1;
    _fstrncat(buf, cmdtail, len);

    /* Send the request to CLIPSRV */
    PutClipString(buf);

    /* if asked server to exit, not going to be a reply! */
    if (strcmp(argv[1], "EXIT") != 0)
    {
        /* Wait for CLIPSRV for reply. As long as the clipboard
        contents still match the request we put in there, we know
        that CLIPSRV hasn't responded yet. Yield() to give
        CLIPSRV a chance. Because 2F/1680 Yield doesn't work so
        good, especially in 3.1 Enhanced mode, Yield (in WINCLIP.C)
        does a few INT 28h Idle calls instead */
        while (strcmp(buf, s = GetClipString()) == 0)
        {
            Yield();
            if (i++ > 10)
                cleanup("CLIPSRV went down", 1);
            FreeClipString(s);
        }

        /* Finally, the clipboard contents have been changed, hopefully
        by CLIPSRV. (We could check for the case of other programs
        changing the clipboard at just the wrong moment, but this
        works fine in practice.) So we display what is hopefully
        CLIPSRV's reply. */
        puts(s);

        FreeClipString(s);
    }

    /* Free up memory, restore the old clipboard contents, and leave */
    cleanup(NULL, 0);
    return 0;
}

```

Figure 10: The CMDCLIP program is a superior alternative to the batch file approach embodied in Figure 9.

easiest way is to use the PUTCLIP program, shown in Figure 7, where NOTEPAD is running and where the DOS box has changed its own window title.

The code in the full-blown CLIPSRV1.C very much resembles that in the earlier overview of Figure 2. The key function in this code listing is check_clipboard(), which is called every time the program receives a WM_DRAWCLIPBOARD message. In addition to

testing for Clipboard changes from the DOS box and for the CMDCLIP identifier that begins each command/request, check_clipboard() makes a local copy of the Clipboard contents, peels off the identifier, and then uses the remaining string as a parameter to a private message, WM_CLIPCMD.

The function clipcmd() is the handler for these private WM_CLIPCMD messages. It checks for the three built-in com-

mands and dispatches to the appropriate function. For example, RUN calls do_run(), which turns into a WinExec().

To use CLIPSRV1, you can add CLIPSRV1.EXE to the RUN= line in WIN.INI, or run it from Program Manager or another Windows shell. Remember that the program has no window and will appear to do nothing when you run it. Also remember that unless CLIPSRV1 is running, putting a string like

```
CMDCLIP RUN notepad.exe
```

into the Clipboard will do nothing more than put that string into the Clipboard. CLIPSRV1 is required to turn this string into a command.

On the other hand, CLIPSRV1 is *all* that is required. As you can see simply by hanging a few lines of C code off the Clipboard as an odd kind of Clipboard "viewer," we've opened up some of the Windows API to DOS programs.

GETTING BACK RETURN VALUES If you want to give DOS programs access to additional API calls, all you have to do is come up with another command and have it dispatch to the appropriate function. For example, REGCLPFMT might call RegisterClipboardFormat(), and GETVERS might call GetVersion().

This last suggestion discloses a problem: How can the DOS program get the *return values* from these functions? Actually, the problem was present even in CMDCLIP RUN and WinExec(), because the DOS program that currently puts a CMDCLIP RUN into the Clipboard has no way of knowing whether the underlying WinExec() call succeeded. As written, CLIPSRV1 simply throws away the return value from WinExec().

Well, CLIPSRV1 was just an experiment. We now can write the real Clipboard server, CLIPSERV. The first thing to do, then, is to tweak the built-in commands so they can do something intelligent with return values. CLIPSERV should put a return value *back* in the Clipboard as a reply to the DOS program's request. That way, the DOS program can be told whether its request made it over the Windows wall and that the Clipboard server is indeed running.

To accomplish this, Figure 8 shows a changed version of the do_run() function, together with a new function, put_clip_str(). With this code in place, CLIPSERV will respond to a

```
CMDCLIP RUN x
```

by running

```
retval = WinExec("x", SW_NORMAL)
```

CLIPSERV will then place

```
CLIPREPLY RUN
```

followed by a string representation of retval back into the Clipboard.

To retrieve this reply, you could always follow a PUTCLIP CMDCLIP by running the GETCLIP program presented in last issue's Lab Notes. Figure 9 shows how a DOS batch file, CLIPRUN, could do this.

BASHING THE CLIPBOARD CLIPRUN.BAT is not what I would call a triumphant piece of work, though. For one thing, to interpret the rather cryptic results it displays you must know that WinExec() returns a number greater than 32 when it succeeds. Further, CLIPRUN is timing-dependent: If GETCLIP runs before the CLIPSERV has carried out the request, you can get an inappropriate return value in the Clipboard. And, of course, what happens if CLIPSERV isn't running at all?

Thinking about these questions opens up another, equally fundamental problem that you may have been wondering about all along: What happens to the original contents of the Clipboard?

The Clipboard is a great vehicle for sending DOS requests to a Windows server, both because DOS programs have access to the Clipboard via the Enhanced mode INT 2Fh API and because it's easy to write servers that hang off the Clipboard waiting for WM_DRAWCLIPBOARD messages instead of wasting CPU time with polling. The Clipboard has a serious limitation in that there is *only one*, which any program can use whenever it wants. The moral is that whenever an alternative viewer program uses the Clipboard, it should clean up after itself. Once a CLIPSERV transaction is completed, the previous contents of the Clipboard should be restored.

My initial plan was to rely on Richard Hale Shaw's CLIPSTAC program (*PC Magazine*, August 1992) to do this. CLIPSTAC actually provides an API with such messages as WM_CLIPSTACPUSH and WM_CLIPSTACPOP. The saving and restoring of the Clipboard contents, however, should really be done by the DOS program. With CLIPSERV in place, it would be easy for DOS programs to make the necessary SendMessage() calls to communicate with CLIPSTAC. But this presents the same sort of chicken-and-egg problem that we saw with RegisterClipboardFormat(). Basically, what-

ever underlying mechanism CLIPSERV uses, it needs to be something that doesn't require CLIPSERV!

What's needed instead of CLIPSTAC is a new DOS program that is better than lashing PUTCLIP and GETCLIP together into CLIPRUN.BAT. This DOS program, for which CMDCLIP seems a natural name, uses the WINCLIP library functions—PutClipString() and GetClipString()—that were presented in Part I as the basis of PUTCLIP and GETCLIP. In essence, CMDCLIP:

- Ensures that CLIPSERV is running;
- Saves the current Clipboard contents;
- Puts a request in the Clipboard;
- Waits to get back a reply;
- Displays the reply;
- Restores the saved Clipboard contents.

CMDCLIP.C is shown in Figure 10. The comments in the source code explain how it all works except for the Clipserve() install-check function. CMDCLIP determines whether CLIPSERV is running by applying a kind of distant cousin of the Turing Test. That is to say, Clipserve(), which is part of CMDCLIP.C and is listed in Figure 10, tosses a string into the Clipboard. (The previous contents of the Clipboard have already been saved.) It then checks to see whether an intelligent-looking response appears in the Clipboard shortly thereafter (making it somewhat timing-dependent). If one does, CLIPSERV (or a reasonable imposter) must be running. This requires that CLIPSERV respond appropriately to these install-check messages; this additional code for CLIPSERV is:

```
if (_fstrcmp(cmd, "INSTCHECK")== 0)
    put_clip_str(hwnd, "CLIPREPLY
    INSTOK");
```

Everything is now in place except for the code that makes CLIPSERV truly general purpose. Surprisingly, adding this code—which uses a feature of Windows called runtime dynamic linking—is fairly easy, as I will demonstrate in this column in the next issue. □

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Recording and Playing Back MIDI Sequences

BY CHARLES PETZOLD

One of the dangers of being a pioneer is that sometimes you get lost. Programming for the Multimedia Extensions for Microsoft Windows is fairly new, and it's often quite different from normal Windows programming. Because programming guidelines and existing code samples are not always clear, it's possible to make mistakes.

In the December 31, 1991, installment of this column, I described a program called RECORD1 that used the low-level waveform audio functions to record and play back sound. After this program was published, I was politely faulted by some of Microsoft's programmers for several flaws in the code.

PROBLEMS WITH RECORD1 When you use the low-level waveform audio functions to record sound, you pass buffers to the API. While recording, the system fills these buffers with waveform audio data and then passes them back to your program. To play back the sound, you pass filled buffers to the API; your program is notified when the buffers have finished being played.

In RECORD1, I passed the buffers to the API one at a time. I should have used a technique called *double-buffering*. When recording sound, a program should first pass two buffers to the API, then pass a third buffer when the first one is returned to the program. This ensures that there is always a buffer present to receive data. Otherwise, some data may be missed during the time one buffer is returned to the program and the second sent out. Double-buffering is also a good idea when playing back waveform audio sound to prevent any gaps in the playback.

The second problem in RECORD1 is

that I frequently (and unnecessarily) called `waveInPrepareHeader` and `waveInUnprepareHeader`. As you'll recall, these functions call `GlobalPageLock` and `GlobalPageUnlock` for both the `WAVEHDR` structure and the buffer it references. (The memory for both the structure and buffer must be allocated using `GlobalAlloc`.) Performing a page lock keeps the memory block at the same

*With the help of a DLL
that extends the low-level
MIDI API, our sample
program uses buffered input
and output to record and play
back MIDI messages.*

physical address in memory and—when Windows is running in 386 Enhanced mode—prevents it from being swapped out to disk. This is necessary for memory that must be accessed by the system at hardware interrupt time.

However, in RECORD1 I called the `waveInPrepareHeader` and `waveInUnprepareHeader` functions far too often, adding unnecessary overhead to the time between one buffer being returned to the program and the next being sent out through the API.

I made a third error in RECORD1 when I didn't check whether `waveInPrepareHeader` or `waveOutPrepareHeader` succeeded or failed. When Windows is running in 386 Enhanced mode, it makes use of virtual memory. That is, hard disk space is used for swapping code and data

segments in and out of real memory. Because of this, there is a large amount of global memory available. If you obtain an error from a `GlobalAlloc` call, it means you've run out of both physical memory and disk space for swapping.

The success of `waveInPrepareHeader` and `waveOutPrepareHeader`, however, depends on the success of `GlobalPageLock`, which in turn depends on the availability of physical memory installed in the system. Thus, although a `GlobalAlloc` call may succeed because there is plenty of disk space available, `GlobalPageLock` can fail due to insufficient physical memory. When you use a lot of page-locked memory, it is just about guaranteed that a `GlobalPageLock` call will fail long before `GlobalAlloc` does.

LET'S TRY IT AGAIN I carefully considered these criticisms of RECORD1 while working on the MIDREC ("MIDI Record," shortened to the six-character CompuServe filename maximum) program shown in this column. MIDREC makes use of the MIDBUF dynamic link library that I described in the last column. MIDBUF implements an extension to the Windows multimedia API to allow a program to use buffered input and output to record and play back sequences of MIDI messages. You use this API extension in a very similar manner to the low-level waveform audio functions.

I'll assume here that you have a MIDI board (or a synthesizer board with a MIDI connector box) installed, and that you've installed a Windows driver for this board. I'll also assume that you have a MIDI keyboard (or other MIDI controller), and that you've connected the MIDI Out port of the keyboard to the MIDI In port of the MIDI board.

When you use MIDREC to record,

MIDI messages come from the keyboard and are stored in memory. You can then play back the MIDI sequence on an internal or external synthesizer.

Figures 1 through 6 list the source code for the MIDREC program. You can compile the program from the DOS command line using either the Microsoft C/C++ 7.0 compiler (with the Windows Software Development Kit), or the Borland C++ 3.1 compiler. For the Microsoft compiler, use

```
NMAKE MIDREC.MSC
```

and for the Borland compiler, use

```
MAKE -f MIDREC.BCP
```

Both compilers include all the header files and import libraries necessary for creating Windows programs that take advantage of the Multimedia Extensions. You'll also need the MIDBUF.H header file and MIDBUF.LIB import library for compiling the program, and MIDBUF.DLL for running it. You can download all MIDBUF and MIDREC files from PC MagNet, or you can get them

on-disk by sending a postcard with your name and address to PC Magazine, Attention Katherine West, Environments, One Park Avenue, New York, NY 10016. No phone calls, please.

The program's main window has five buttons in two rows: Record and End on

*When recording a
MIDI sequence, it's nice
to hear what you're
playing. Sometimes this
is possible, and
sometimes it isn't.*

the first; Play, Pause, and End on the second. Buttons are enabled only when it is valid to press them. When the program begins execution, only the Record button is enabled. If you press Record, you enable only the first End button. At this point, you can bang away at a MIDI keyboard connected to the MIDI In port of

your MIDI board. (Before playing the keyboard, though, it's a good idea to press one of the instrument buttons on the keyboard to store a MIDI Program Change message.) Press End to stop recording.

After you record a sequence of MIDI messages, both the Record and Play buttons are enabled. You can re-record a MIDI sequence (erasing the first) by pressing Record, or play back the MIDI sequence by pressing Play, which enables the Pause and End buttons. If you press Pause, playback is halted and the button appears with the text Resume. Otherwise, MIDREC plays the MIDI sequence through the synthesizer.

INPUT, MONITOR, AND OUTPUT MIDREC also includes a menu with a single item labeled Device. The Device submenu lists three types of devices—Input, Monitor, and Output. These invoke three additional submenus that list the available MIDI devices installed on the system. These devices are added to the program's menu by MIDREC's AddDevicesToMenu function.

The Input submenu lists all MIDI input devices. The number of devices is obtained from the midiInGetNumDevs function, and the device names are obtained from midiInGetDevCaps. If you have a single MIDI In port on a single MIDI board (the usual case), you'll see just one device on this list. If you have more than one MIDI input device, you can use this menu to select the device from which you wish to record MIDI sequences.

The Output submenu lists all the MIDI output devices, including the MIDI Mapper device (if the MIDI Mapper is installed) as well as the real output devices (the number of which is obtained from midiOutGetNumDevs). Typically, you'll see three devices listed—the MIDI Mapper, the internal synthesizer, and the MIDI Out port of the MIDI board, which may be connected to an external synthesizer. The MIDI Mapper device is checked as a default, but you can select a different output device for playback if you wish.

When recording a MIDI sequence, it's always nice to hear what you're playing. Sometimes it's possible to configure your hardware to allow this, and sometimes it isn't. For example, my external synthe-

MIDREC.MSC

Complete Listing

```
#-----
# MIDREC.MSC make file for Microsoft C 7.0
#-----

midrec.exe : midrec.obj midrec.def midrec.res midbuf.lib
link midrec,, NUL, /nod midbuf slibcew oldnames libw mmsystem, midrec
rc -t midrec.res

midrec.obj : midrec.c midrec.h midbuf.h
cl -c -G2sw -Ow -W3 -Zp -Tp midrec.c

midrec.res : midrec.rc midrec.h
rc -r midrec.rc
```



Figure 1: This is the make-file for compiling with Microsoft C/C++ 7.0 using the Windows SDK.

MIDREC.BCP

Complete Listing

```
#-----
# MIDREC.BCP make file for Borland C++ 3.1
#-----

midrec.exe : midrec.obj midrec.def midrec.res midbuf.lib
tlink /c /n /Tw /Lc:\borlandc\lib c0ws midrec, midrec, NUL, \
midbuf import mathws cws, midrec
rc -t midrec.res

midrec.obj : midrec.c midrec.h midbuf.h
bcc -c -w-par -P -W -2 midrec.c

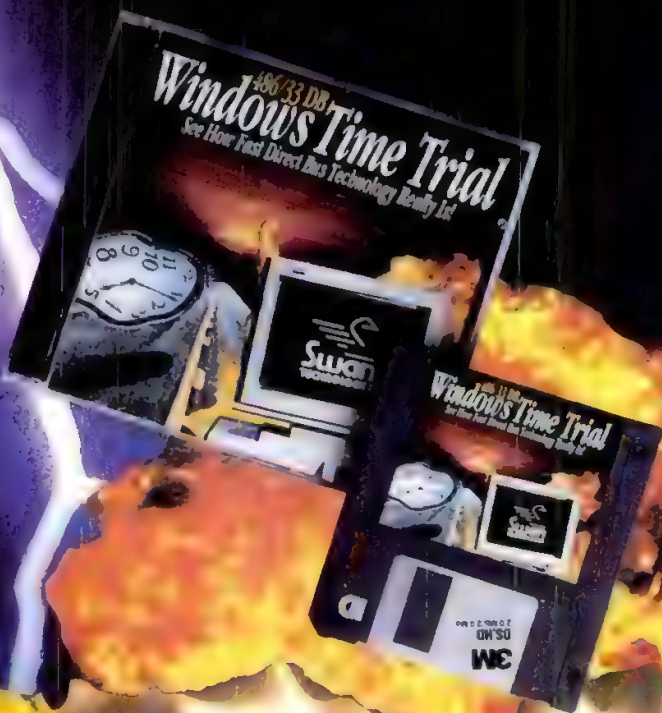
midrec.res : midrec.rc midrec.h
rc -r -ic:\borlandc\include midrec.rc
```



Figure 2: This is the make-file for use with Borland C++ 3.1.

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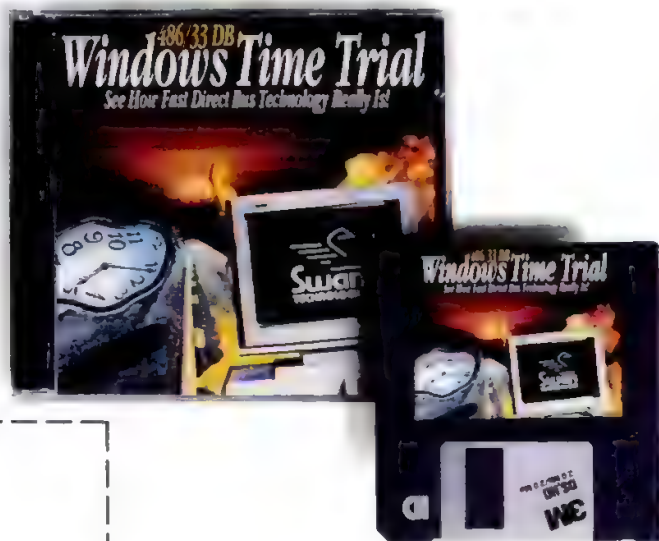
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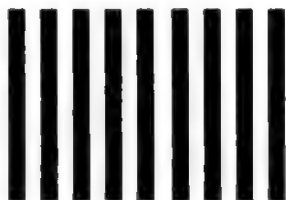
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MIDREC.C

1 of 3



```

/*-----
MIDREC.C -- MIDI Recorder and Player
(c) Charles Petzold, 1992
-----*/

#include <windows.h>
#include <windowsx.h>
#include <mmsystem.h>
#include <string.h>
#include "midbuf.h"
#include "midrec.h"

#define BUFFER_SIZE 4096 // Should be multiple of 8

BOOL FAR PASCAL _export DlgProc (HWND, UINT, WPARAM, LONG);

static char szAppName [] = "MidRec";

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
LPSTR lpzCmdLine, int nCmdShow)
{
    FARPROC lpDlgProc;

    lpDlgProc = MakeProcInstance ((FARPROC) DlgProc, hInstance);
    DialogBox (hInstance, szAppName, NULL, lpDlgProc);
    FreeProcInstance (lpDlgProc);

    return 0;
}

// Functions to allocate and free MIDIDHR structures and buffers
// -----

LPMIDIDHR AllocMidiHeader (HANDLE hMidi, LPMIDIDHR pmhRoot)
{
    LPMIDIDHR pmhNew, pmhNext;

    // Allocate memory for the new MIDIDHR

    pmhNew = (LPMIDIDHR) GlobalAllocPtr (GHND | GMEM_SHARE, sizeof (MIDIDHR));

    if (pmhNew == NULL)
        return NULL;

    // Allocate memory for the buffer

    pmhNew->lpData = (LPSTR) GlobalAllocPtr (GHND | GMEM_SHARE, BUFFER_SIZE);

    if (pmhNew->lpData == NULL)
    {
        GlobalFreePtr (pmhNew);
        return NULL;
    }

    pmhNew->dwBufferLength = BUFFER_SIZE;

    // Prepare the header

    if (midiInPrepareHeader (hMidi, pmhNew, sizeof (MIDIDHR)))
    {
        GlobalFreePtr (pmhNew->lpData);
        GlobalFreePtr (pmhNew);
        return NULL;
    }

    // Attach new header to end of chain

    if (pmhRoot != NULL)
    {
        pmhNext = pmhRoot;

        while (pmhNext->dwUser != NULL)
            pmhNext = (LPMIDIDHR) pmhNext->dwUser;

        pmhNext->dwUser = (DWORD) pmhNew;
    }

    return pmhNew;
}

LPMIDIDHR CleanUpMidiHeaderChain (HANDLE hMidi, LPMIDIDHR pmhRoot)
{
    LPMIDIDHR pmhCurr, pmhLast, pmhNext, pmhRetn;

    pmhRetn = pmhRoot;
    pmhCurr = pmhRoot;
    pmhLast = NULL;

    while (pmhCurr != NULL)
    {
        pmhNext = (LPMIDIDHR) pmhCurr->dwUser;

        if (pmhCurr->dwBytesRecorded == 0)
        {
            midiInUnprepareHeader (hMidi, pmhCurr, sizeof (MIDIDHR));

            GlobalFreePtr (pmhCurr->lpData);
            GlobalFreePtr (pmhCurr);

            if (pmhCurr == pmhRoot)

```

```

                pmhRetn = NULL;

                if (pmhLast != NULL)
                    pmhLast->dwUser = (DWORD) pmhNext;

                pmhCurr = pmhLast;
            }

            else if (pmhCurr->dwBytesRecorded < BUFFER_SIZE)
            {
                midiInUnprepareHeader (hMidi, pmhCurr, sizeof (MIDIDHR));

                GlobalFreePtr (pmhCurr->lpData);
                pmhCurr->dwBytesRecorded = 0;

                midiInPrepareHeader (hMidi, pmhCurr, sizeof (MIDIDHR));

                pmhCurr->dwBufferLength = pmhCurr->dwBytesRecorded;
            }

            pmhLast = pmhCurr;
            pmhCurr = pmhNext;
        }

        return pmhRetn;
    }

VOID FreeMidiHeaderChain (HANDLE hMidi, LPMIDIDHR pmhRoot)
{
    LPMIDIDHR pmhNext, pmhTemp;

    pmhNext = pmhRoot;

    while (pmhNext != NULL)
    {
        pmhTemp = (LPMIDIDHR) pmhNext->dwUser;

        midiInUnprepareHeader (hMidi, pmhNext, sizeof (MIDIDHR));

        GlobalFreePtr (pmhNext->lpData);
        GlobalFreePtr (pmhNext);

        pmhNext = pmhTemp;
    }

    // Add MIDI device lists to the program's menu
    // -----

WORD AddDevicesToMenu (HWND hwnd, int iNumInpDevs, int iNumOutDevs)
{
    HMENU hMenu, hMenuInp, hMenuMon, hMenuOut;
    int i;
    MIDIINCAPS mic;
    MIDIOUTCAPS moc;
    WORD wDefaultOut;

    hMenu = GetMenu (hwnd);

    // Create "Input" popup menu

    hMenuInp = CreateMenu ();

    for (i = 0; i < iNumInpDevs; i++)
    {
        midiInGetDevCaps (i, &mic, sizeof (MIDIINCAPS));
        AppendMenu (hMenuInp, MF_STRING, ID_DEV_INP + i, mic.szPname);
    }

    CheckMenuItem (hMenuInp, 0, MF_BYPOSITION | MF_CHECKED);
    ModifyMenu (hMenu, ID_DEV_INP, MF_POPUP, hMenuInp, "Input");

    // Create "Monitor" and "Output" popup menus

    hMenuMon = CreateMenu ();
    hMenuOut = CreateMenu ();

    AppendMenu (hMenuMon, MF_STRING, ID_DEV_MON, "&None");

    if (!midiOutGetDevCaps (MIDIMAPPER, &moc, sizeof (moc)))
    {
        AppendMenu (hMenuMon, MF_STRING, ID_DEV_MON + 1, moc.szPname);
        AppendMenu (hMenuOut, MF_STRING, ID_DEV_OUT, moc.szPname);

        wDefaultOut = 0;
    }

    else
        wDefaultOut = 1;

    // Add the rest of the MIDI devices

    for (i = 0; i < iNumOutDevs; i++)
    {
        midiOutGetDevCaps (i, &moc, sizeof (moc));
        AppendMenu (hMenuMon, MF_STRING, ID_DEV_MON + i + 2, moc.szPname);
        AppendMenu (hMenuOut, MF_STRING, ID_DEV_OUT + i + 1, moc.szPname);
    }

    CheckMenuItem (hMenuMon, 0, MF_BYPOSITION | MF_CHECKED);
    CheckMenuItem (hMenuOut, 0, MF_BYPOSITION | MF_CHECKED);
}

```

Figure 3: This listing contains all source code for the program.

MIDREC.C

2 of 3

```

ModifyMenu (hMenu, ID_DEV_MON, MF_POPUP, hMenuMon, "&Monitor");
ModifyMenu (hMenu, ID_DEV_OUT, MF_POPUP, hMenuOut, "&Output");

return wDefaultOut;
}

BOOL FAR PASCAL _export DlgProc (HWND hwnd, UINT message, UINT wParam,
                                LONG lParam)
{
    static BOOL      bRecording, bPlaying, bEnding, bPaused, bTerminating;
    static char      szInpError[] = { "Error opening MIDI input port!" };
    static char      szOutError[] = { "Error opening MIDI output port!" };
    static char      szMonError[] = { "Error opening MIDI output port "
                                      "for monitoring input! Continuing." };
    static char      szMemError[] = { "Error allocating memory!" };
    static HMIDIIN    hMidiIn;
    static HMIDIOUT    hMidiOut;
    static int        iNumInpDevs, iNumOutDevs;
    static LPMIDHDR    pMidiHdrRoot, pMidiHdrNext, pMidiHdr;
    static WORD        wDeviceInp, wDeviceMon, wDeviceOut;
    HMENU             hMenu;
    int               i;

    switch (message)
    {
        case WM_INITDIALOG:

            if (0 == (iNumInpDevs = midiInGetNumDevs ()))
            {
                MessageBox (hwnd, "No MIDI Input Devices!", szAppName,
                            MB_ICONEXCLAMATION | MB_OK);
                DestroyWindow (hwnd);
            }

            if (0 == (iNumOutDevs = midiOutGetNumDevs ()))
            {
                MessageBox (hwnd, "No MIDI Output Devices!", szAppName,
                            MB_ICONEXCLAMATION | MB_OK);
                DestroyWindow (hwnd);
            }

            wDeviceOut = AddDevicesToMenu (hwnd, iNumInpDevs, iNumOutDevs);

            return TRUE;

        case WM_COMMAND:
            hMenu = GetMenu (hwnd);

            switch (wParam)
            {
                case ID_RECORD_BEG:

                    // Open MIDI In port for recording

                    if (midiInOpen (&hMidiIn, wDeviceInp, hwnd, 0L,
                                    CALLBACK_WINDOW))
                    {
                        MessageBox (hwnd, szInpError, szAppName,
                                    MB_ICONEXCLAMATION | MB_OK);

                        return TRUE;
                    }

                    // Open MIDI Out port for monitoring
                    // (continue if unable to open it)

                    if (wDeviceMon > 0)
                    {
                        if (midiOutOpen (&hMidiOut, wDeviceMon - 2,
                                        0L, 0L, 0L))
                        {
                            hMidiOut = NULL;
                            MessageBox (hwnd, szMonError, szAppName,
                                        MB_ICONEXCLAMATION | MB_OK);
                        }
                    }
                    else
                        hMidiOut = NULL;

                    return TRUE;

                case ID_RECORD_END:

                    // Reset and close input

                    bEnding = TRUE;

                    midiInReset (hMidiIn);
                    midiInClose (hMidiIn);

                    return TRUE;

                case ID_PLAY_BEG:

                    // Open MIDI Out port for playing

                    if (midiOutOpen (&hMidiOut, wDeviceOut - 1,
                                    hwnd, 0L, CALLBACK_WINDOW))
                    {
                        MessageBox (hwnd, szOutError, szAppName,
                                    MB_ICONEXCLAMATION | MB_OK);

```

```

                    }

                    return TRUE;

                case ID_PLAY_PAUSE:

                    // Pause or restart output

                    if (!bPaused)
                    {
                        midiOutPause (hMidiOut);

                        // All Notes Off message

                        for (i = 0; i < 16; i++)
                            midiOutShortMsg (hMidiOut, 0x7BB0 + i);

                        SetDlgItemText (hwnd, ID_PLAY_PAUSE, "Resume");
                        bPaused = TRUE;
                    }
                    else
                    {
                        midiOutRestart (hMidiOut);
                        SetDlgItemText (hwnd, ID_PLAY_PAUSE, "Pause");
                        bPaused = FALSE;
                    }

                    return TRUE;

                case ID_PLAY_END:

                    // Reset the port and close it

                    bEnding = TRUE;
                    midiOutReset (hMidiOut);
                    midiOutClose (hMidiOut);
                    return TRUE;

                default:
                    break;
            }

            if (wParam >= ID_DEV_INP & wParam < ID_DEV_MON)
            {
                CheckMenuItem (hMenu, wDeviceInp + ID_DEV_INP,
                                MF_UNCHECKED);

                wDeviceInp = wParam - ID_DEV_INP;

                CheckMenuItem (hMenu, wDeviceInp + ID_DEV_INP,
                                MF_CHECKED);

                return 0;
            }

            else if (wParam >= ID_DEV_MON & wParam < ID_DEV_OUT)
            {
                CheckMenuItem (hMenu, wDeviceMon + ID_DEV_MON,
                                MF_UNCHECKED);

                wDeviceMon = wParam - ID_DEV_MON;

                CheckMenuItem (hMenu, wDeviceMon + ID_DEV_MON,
                                MF_CHECKED);

                return 0;
            }

            if (wParam >= ID_DEV_OUT)
            {
                CheckMenuItem (hMenu, wDeviceOut + ID_DEV_OUT,
                                MF_UNCHECKED);

                wDeviceOut = wParam - ID_DEV_OUT;

                CheckMenuItem (hMenu, wDeviceOut + ID_DEV_OUT,
                                MF_CHECKED);

                return 0;
            }

            break;

        case WM_MIM_OPEN:
            hMidiIn = wParam;

            // Free existing headers

            FreeMidiHeaderChain (hMidiIn, pMidiHdrRoot);

            // Allocate root header

            if (NULL == (pMidiHdrRoot = AllocMidiHeader (hMidiIn, NULL)))
            {
                midiInClose (hMidiIn);
                MessageBox (hwnd, szMemError, szAppName,
                            MB_ICONEXCLAMATION | MB_OK);

                return TRUE;
            }

            // Allocate next header

            if (NULL == (pMidiHdrNext = AllocMidiHeader (hMidiIn,
                                                         pMidiHdrRoot)))

```


MIDREC.C

3 of 3

```

{
    FreeMidiHeaderChain (hMidiIn, pMidiHdrRoot) ;
    midiInClose (hMidiIn) ;
    MessageBox (hwnd, szMemError, szAppName,
        MB_ICONEXCLAMATION | MB_OK) ;

    return TRUE ;
}

// Enable and disable buttons

EnableWindow (GetDlgItem (hwnd, ID_RECORD_BEG), FALSE) ;
EnableWindow (GetDlgItem (hwnd, ID_RECORD_END), TRUE) ;
EnableWindow (GetDlgItem (hwnd, ID_PLAY_BEG), FALSE) ;
EnableWindow (GetDlgItem (hwnd, ID_PLAY_PAUSE), FALSE) ;
EnableWindow (GetDlgItem (hwnd, ID_PLAY_END), FALSE) ;
SetFocus (GetDlgItem (hwnd, ID_RECORD_END)) ;

// Submit the buffers for receiving data

midiInShortBuffer (hMidiIn, pMidiHdrRoot, sizeof (MIDIHDR)) ;
midiInShortBuffer (hMidiIn, pMidiHdrNext, sizeof (MIDIHDR)) ;

// Begin recording

midiInStart (hMidiIn) ;
bRecording = TRUE ;
bEnding = FALSE ;
return TRUE ;

case MM_MIM_DATA:
    if (hMidiOut)
    {
        midiOutShortMsg (hMidiOut, lParam) ;
    }

    return TRUE ;

case MM_MIM_LONGDATA:

    if (bEnding)
        return TRUE ;

    pMidiHdrNext = AllocMidiHeader (hMidiIn, pMidiHdrRoot) ;

    if (pMidiHdrNext == NULL)
    {
        midiInReset (hMidiIn) ;
        midiInClose (hMidiIn) ;
        MessageBox (hwnd, szMemError, szAppName,
            MB_ICONEXCLAMATION | MB_OK) ;

        return TRUE ;
    }

    midiInShortBuffer (hMidiIn, pMidiHdrNext, sizeof (MIDIHDR)) ;

    return TRUE ;

case MM_MIM_CLOSE:

    // Close the monitoring output port

    if (hMidiOut)
    {
        midiOutReset (hMidiOut) ;
        midiOutClose (hMidiOut) ;
    }

    // Enable and Disable Buttons

    EnableWindow (GetDlgItem (hwnd, ID_RECORD_BEG), TRUE) ;
    EnableWindow (GetDlgItem (hwnd, ID_RECORD_END), FALSE) ;
    SetFocus (GetDlgItem (hwnd, ID_RECORD_BEG)) ;

    pMidiHdrRoot = CleanUpMidiHeaderChain (hMidiIn, pMidiHdrRoot) ;

    if (pMidiHdrRoot != NULL)
    {
        EnableWindow (GetDlgItem (hwnd, ID_PLAY_BEG), TRUE) ;
        EnableWindow (GetDlgItem (hwnd, ID_PLAY_PAUSE), FALSE) ;
        EnableWindow (GetDlgItem (hwnd, ID_PLAY_END), FALSE) ;
        SetFocus (GetDlgItem (hwnd, ID_PLAY_BEG)) ;
    }

    bRecording = FALSE ;

    if (bTerminating)
    {
        FreeMidiHeaderChain (hMidiIn, pMidiHdrRoot) ;
        SendMessage (hwnd, WM_SYSCOMMAND, SC_CLOSE, 0L) ;
    }

    return TRUE ;

case MM_MOM_OPEN:
    hMidiOut = wParam ;

    // Enable and Disable Buttons

    EnableWindow (GetDlgItem (hwnd, ID_RECORD_BEG), FALSE) ;
    EnableWindow (GetDlgItem (hwnd, ID_RECORD_END), FALSE) ;

```

```

    EnableWindow (GetDlgItem (hwnd, ID_PLAY_BEG), FALSE) ;
    EnableWindow (GetDlgItem (hwnd, ID_PLAY_PAUSE), TRUE) ;
    EnableWindow (GetDlgItem (hwnd, ID_PLAY_END), TRUE) ;
    SetFocus (GetDlgItem (hwnd, ID_PLAY_END)) ;

    // Submit the root buffer to begin playing

    midiOutShortBuffer (hMidiOut, pMidiHdrRoot, sizeof (MIDIHDR)) ;

    // If there's a second buffer, submit that also

    if (NULL != (pMidiHdr = (LPMIDIHDR) pMidiHdrRoot->dwUser))
        midiOutShortBuffer (hMidiOut, pMidiHdr, sizeof (MIDIHDR)) ;

    bEnding = FALSE ;
    bPlaying = TRUE ;
    return TRUE ;

case MM_MOM_DONE:

    // If stopping playback, just return

    if (bEnding)
        return TRUE ;

    // Get header of buffer just finished playing

    pMidiHdr = (LPMIDIHDR) lParam ;

    // Get header of next buffer (already submitted)

    pMidiHdr = (LPMIDIHDR) pMidiHdr->dwUser ;

    // Get header of next buffer to submit now

    if (pMidiHdr != NULL)
        pMidiHdr = (LPMIDIHDR) pMidiHdr->dwUser ;

    if (pMidiHdr != NULL)
        midiOutShortBuffer (hMidiOut, pMidiHdr, sizeof (MIDIHDR)) ;
    else
    {
        midiOutReset (hMidiOut) ;
        midiOutClose (hMidiOut) ;
    }

    return TRUE ;

case MM_MOM_CLOSE:

    // Enable and Disable Buttons

    EnableWindow (GetDlgItem (hwnd, ID_RECORD_BEG), TRUE) ;
    EnableWindow (GetDlgItem (hwnd, ID_RECORD_END), TRUE) ;
    EnableWindow (GetDlgItem (hwnd, ID_PLAY_BEG), TRUE) ;
    EnableWindow (GetDlgItem (hwnd, ID_PLAY_PAUSE), FALSE) ;
    EnableWindow (GetDlgItem (hwnd, ID_PLAY_END), FALSE) ;
    SetFocus (GetDlgItem (hwnd, ID_PLAY_BEG)) ;

    SetDlgItemText (hwnd, ID_PLAY_PAUSE, "Pause") ;
    bPaused = FALSE ;
    bPlaying = FALSE ;

    if (bTerminating)
    {
        FreeMidiHeaderChain (hMidiIn, pMidiHdrRoot) ;
        SendMessage (hwnd, WM_SYSCOMMAND, SC_CLOSE, 0L) ;
    }

    return TRUE ;

case WM_SYSCOMMAND:
    switch (wParam)
    {
        case SC_CLOSE:
            if (bRecording)
            {
                bTerminating = TRUE ;
                bEnding = TRUE ;
                midiInReset (hMidiIn) ;
                midiInClose (hMidiIn) ;
                return TRUE ;
            }

            if (bPlaying)
            {
                bTerminating = TRUE ;
                bEnding = TRUE ;
                midiOutReset (hMidiOut) ;
                midiOutClose (hMidiOut) ;
                return TRUE ;
            }

            EndDialog (hwnd, 0) ;
            return TRUE ;
        }
    }
    break ;

return FALSE ;
}

```

size is a Roland SC-55 containing a MIDI In port in the front of the box and MIDI In, MIDI Thru, and MIDI Out ports in the back. MIDI messages coming into both MIDI In ports are combined to play the synthesizer. The MIDI Thru port is an output port that duplicates MIDI input messages coming into the MIDI In port on the back of the box (but not the one on the front).

Figure 7 shows how a MIDI keyboard, the Roland SC-55, and a MIDI board (such as the Sound Blaster with the MIDI connector box) can be connected so you can use MIDREC to record from the keyboard and play back over the Roland SC-55. While playing the keyboard (with or

without MIDREC running), you'll be able to monitor what you're playing on the synthesizer.

Some MIDI boards have their own MIDI Thru ports that duplicate what comes into the board through the MIDI In port. You may need a MIDI mixer to combine the MIDI Thru output and the MIDI Out output to run into an external synthesizer.

If none of these hardware connections are possible, you may be able to monitor your playing through software. This is the purpose of the Monitor submenu, which lists all the MIDI output devices, including an additional option—None—that is checked by default. If you select an out-

MIDREC.H

Complete Listing

```
/*-----
MIDREC.H header file
-----*/

#define ID_RECORD_BEG    10
#define ID_RECORD_END    11
#define ID_PLAY_BEG     12
#define ID_PLAY_PAUSE   13
#define ID_PLAY_END     14

#define ID_DEV_INP      100
#define ID_DEV_MON      200
#define ID_DEV_OUT      300
```



Figure 6: This header file defines constants used for the dialog box and menu.

MIDREC.RC

Complete Listing

```
/*-----
MIDREC.RC resource script
-----*/

#include <windows.h>
#include "midrec.h"

MidRec MENU
{
    POPUP "&Devices"
    {
        MENUITEM "&Input",          ID_DEV_INP
        MENUITEM "&Monitor",         ID_DEV_MON
        MENUITEM "&Output",          ID_DEV_OUT
    }
}

MidRec DIALOG 32768, 0, 152, 52
    STYLE WS_OVERLAPPED | WS_CAPTION | WS_SYSMENU | WS_MINIMIZEBOX |
WS_VISIBLE
    CAPTION "MIDI Player / Recorder"
    MENU MidRec
    [
        DEFPUSHBUTTON "Record" ID_RECORD_BEG, 28, 8, 40, 14
        PUSHBUTTON "End" ID_RECORD_END, 76, 8, 40, 14, WS_DISABLED

        PUSHBUTTON "Play" ID_PLAY_BEG, 8, 30, 40, 14, WS_DISABLED
        PUSHBUTTON "Pause" ID_PLAY_PAUSE, 56, 30, 40, 14, WS_DISABLED
        PUSHBUTTON "End" ID_PLAY_END, 104, 30, 40, 14, WS_DISABLED
    ]
```



Figure 4: This resource script defines the menu and the dialog template used for the program's main window.

MIDREC.DEF

Complete Listing

```
/*-----
MIDREC.DEF module definition file
-----*/

NAME "MIDREC"

DESCRIPTION "MIDI Recorder and Player (c) Charles Petzold, 1992"
EXETYPE WINDOWS
STUB "WINSTUB.EXE"
CODE PRELOAD MOVEABLE DISCARDABLE
DATA PRELOAD MOVEABLE MULTIPLE
HEAPSIZE 1024
STACKSIZE 8192
```



Figure 5: Here is the program's module definition file.

put device on the Monitor submenu, MIDREC will attempt to open that device when recording. All MIDI messages coming from the MIDI input device are then sent to the selected MIDI output device.

However, it's not always possible to arbitrarily select a MIDI output port for monitoring. For example, I'm currently using a Sound Blaster board with a MIDI connector box that contains MIDI In and MIDI Out ports. You can't open both of these ports simultaneously. So, if I use this facility, I'm not able to monitor my playing on an external synthesizer. I can, however, simultaneously open the MIDI In port and the internal synthesizer on the Sound Blaster. I can monitor my playing that way and then play it back over an external synthesizer.

At any rate, you may have to do some experimenting. If you need some help, drop a message on the Programming forum on PC MagNet and we'll see if we can work it out.

THE INNER WORKINGS Much of MIDREC's structure is similar to RECORD1's. The program uses a dialog box as its main window. Messages from the buttons and the menu are processed in the DlgProc function.

When you press the Record button, MIDREC opens the selected MIDI input device and—if you've selected an output device for monitoring—the MIDI output device. If this output device cannot be opened, the program displays a message box but goes ahead with the recording operation.

Opening the MIDI input device generates an MM_MIM_OPEN message.

Configuring Your Hardware for Monitoring

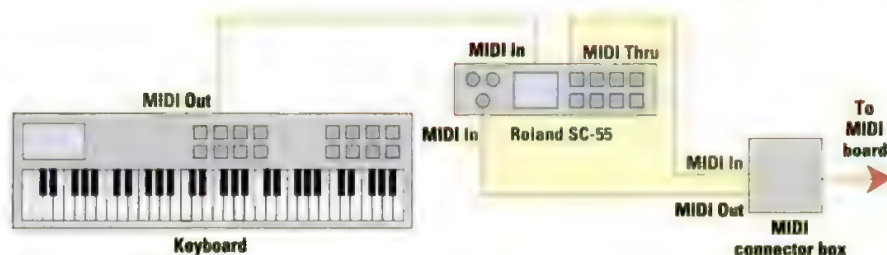


Figure 7: This illustrates one possible configuration for monitoring what you're playing on the keyboard while also recording it.

MIDREC handles this message by allocating two MIDIHDR structures and two buffers that are each 4096 bytes long. This memory allocation is performed in the AllocMidiHeader function in MIDREC.C.

As you might recall, the MIDIHDR structure contains a field called dwUser that a program can use for anything it wants. I use this field in order to maintain a linked list of MIDIHDR structures. A pointer to the first allocated MIDIHDR structure is stored in the static variable pMidiHdrRoot in DlgProc. A pointer to the second allocated MIDIHDR structure is stored in the dwUser field of the first structure. At a later time, a pointer to the third MIDIHDR structure will be stored in the dwUser field of the second structure. The AllocMidiHeader function also calls midiInPrepareHeader to lock the structures and buffers in memory.

If this is successful, MIDREC enables and disables the appropriate buttons on the window, and then calls midiInShortBuffer twice. You won't find this function, which allows for buffered MIDI I/O, listed in the *Multimedia Programmer's Reference* manual. It's part of the extensions I added to the multimedia API in the MIDBUF dynamic link library. MIDREC concludes MM_MIM_OPEN processing by calling midiInStart to enable MIDI input.

Even when using MIDBUF for buffered MIDI I/O, a program still gets MM_MIM_DATA messages that contain individual MIDI messages. If a MIDI output port has been opened for monitoring, these MIDI messages are simply passed to the output device by a call to midiOutShortMsg.

An MM_MIM_LONGDATA mes-

sage indicates that a buffer has been filled and is being returned to the program. MIDREC responds by allocating a new buffer and passing it to the API with another call to midiInShortBuffer. This process continues until the program runs out of memory or until the user presses the End button.

MIDREC responds to either case by calling midiInReset and midiInClose,

*Multimedia Windows
supports MIDI files
through the Media Control
Interface. But MCI can't
record MIDI input into a
MIDI file, so that's a chore
left for us.*

which generates an MM_MIM_CLOSE message, causing MIDREC to call the CleanupMidiHeaderChain function. This function deletes any MIDIHDR structures in the linked list that reference empty buffers, and reallocates the buffer size for any buffer that's only partially filled. If there are any buffers left after this operation, the Play button is enabled. (All the buffers could be empty if you haven't played anything on the MIDI keyboard, or if the keyboard isn't connected properly.)

Pressing Play causes MIDREC to open the selected MIDI output device, generating an MM_MOM_OPEN message. MIDREC responds by enabling and disabling the appropriate buttons

and by passing the first two buffers in the linked list to midiOutShortMessage. This is another of the functions in the extended API that I implemented in the MIDBUF dynamic link library.

As each buffer is finished playing, MIDREC receives an MM_MOM_DONE message, and responds by submitting the next buffer to midiOutShortMessage. If no buffers are left, MIDREC calls midiOutReset and midiOutClose. The appropriate buttons are enabled and disabled during the MM_MOM_CLOSE message.

You can also Pause the playback by making use of the third and fourth new functions, which are implemented in MIDBUF.DLL—midiOutPause and midiOutRestart.

One further note: To simplify global memory allocation under protected mode, I've made use of the GlobalAllocPtr, GlobalFreePtr, and GlobalReAllocPtr macros that are defined in the WINDOWSX.H header file. This header file is included in both the Microsoft Windows SDK and Borland C++, Version 3.1, and defines a number of handy macros. For example, the GlobalAllocPtr macro calls GlobalAlloc and GlobalLock so a program can avoid dealing with global memory handles.

WHAT? NO SAVE FEATURE? If you're annoyed by the fact that MIDREC can't save MIDI sequences to disk and reload them, please be patient. I deliberately resisted adding such a feature to MIDREC because an industry-standard file-format for storing MIDI sequences already exists.

The Multimedia Extensions for Microsoft Windows support MIDI files (with the extension .MID) through the Media Control Interface. Indeed, Microsoft ships Windows 3.1 with a MIDI file that you can play using the Media Player utility. However, MCI cannot record MIDI input into a MIDI file, so that's a chore left for us.

This extended series on the Multimedia Extensions for Windows will culminate with a program that lets you create MIDI files by playing on a MIDI keyboard (or other controller).

Before we get to that, however, we'll need to tackle a couple of preliminaries, including MIDI support under MCI and the MIDI file format. □

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POWER PROGRAMMING

The Windows 3.1 ToolHelp DLL, Part 2

BY RAY DUNCAN

In the last column, I introduced you to Windows 3.1's TOOLHELP.DLL, a dynamic link library that gives you access to previously undocumented Windows data structures and function calls. I had intended to continue in this issue with an example of how to trap General Protection (GP) Faults and other hardware exceptions using TOOLHELP.DLL. But, to be frank, I couldn't get the code into a form that I considered publishable in time. ToolHelp's support for interrupt handling is sufficient to deliver control to your program's routines, but it's inadequate for clean handling of the interrupt. Furthermore, the ToolHelp support is not structured so that you can easily write the entire interrupt handler in a high-level language. I can get the stuff to work, but my current solution just isn't aesthetically appealing.

So I'll let my subconscious work on the ToolHelp interrupt-handler problem for awhile, and look at a different topic this time: the ToolHelp API for inspecting and enumerating the system module list, task list, window classes, and global heap. If you're an experienced Windows programmer, this API will be a pleasant surprise: It's predictable, symmetric, and easy to use; the function names actually make some kind of sense; and it's powerful enough for the needs of just about any system-splunking application.

THE SYSTEM VOYEUR API I think of the ToolHelp functions related to the task list, module list, window class list, and global heap as "voyeur" functions because they let you peek at, but not touch, the corresponding Windows internal data structures. Actually, you don't even get a direct look at the structures—you get a transformed and somewhat massaged

reflection of the actual data, copied into data structures that lie in your application's own address space. The functions fall into two categories (as shown in Figure 1): those that let you "walk" through one of the system's linked lists of data objects, and those that let you retrieve information about a specific data object using a handle or name.

All of the ToolHelp voyeur functions

*A sample program
demonstrates the ToolHelp
API for inspecting
the system module
list, task list, window
classes, and global heap.*

are used in essentially the same way. First, you allocate a data structure specific to the type of information being retrieved: task, module, window class, or global heap block. Next, you enter the function via a far call, passing a far pointer to the data structure and—if you're retrieving information about a particular object rather than walking a list—an additional flag, handle, or string pointer. All of the functions return a TRUE value if successful and a FALSE value if they fail or encounter an error; other information, if any, is placed in the data structure whose address was passed in the original call.

To make this more concrete, let's see how we would enumerate all the active tasks in the system. We need a data structure called TASKENTRY and two API

functions: TaskFirst() and TaskNext(). The data structure must be initialized before use, and the first field of the structure contains the length of the structure, which is used as a sanity check by Windows. The skeleton for a loop that walked the task list would look like this:

```
// allocate the data structure

TASKENTRY te;

// initialize the data structure
memset(&te, 0, sizeof(TASKENTRY));
te.dwSize = sizeof(TASKENTRY);

// now walk the task list
TaskFirst(&te)
do {
    // process results in
    // structure "te" here
} while(TaskNext(&te));
```

Notice that we don't have to worry about the success of the TaskFirst() call because we know that at least one task will always be running: our own program! The functions for walking the module, window, and global heap lists are used in an almost identical fashion.

Now suppose we want to retrieve the information about a specific task directly, rather than walking the task list until we run into it (or not). Assuming we have the task's handle to work with, we can use the TaskFindHandle() function together with the familiar TASKENTRY data structure:

```
// task info data structure
TASKENTRY te;

// handle of task to find
HTASK htask;
```


Power Programming

```
//initialize the data structure
memset(&te, 0, sizeof(TASKENTRY);
te.dwSize = sizeof(TASKENTRY);

// now retrieve task info
if(TaskFindHandle(&te, htask))
    // function was successful
else
    // an error occurred
```

The API functions for retrieving information about a specific module, class, or global heap block work in much the same way (allowing for the data object-specific structures, of course). The functions for the different data object types can also be used in combination; for example, as you walk down the task list, you can use the module handle returned for a task in the TASKENTRY structure together with the ModuleFindHandle() function to fetch the task's ASCIIZ modulename and pathname. Similarly, when walking the global heap, you can use the owner handle returned in the GLOBALENTRY structure for a particular memory block together with the TaskFindHandle() and ModuleFindHandle() functions to find the task or module name of the block's owner.

THE SYSMON PROGRAM With the advent of TOOLHELP.DLL, the creation of programs that used to require weeks of painful experimentation and debugging is now easy and even fun. For this issue, I've written a simple system monitor utility called SYSMON that lets you display all of the system lists we've discussed: tasks, modules, window classes, and the global heap. The C-language source code for SYSMON is listed in Fig-

ure 2, and the complete set of files necessary to build the application, along with the executable file, can be downloaded from PC MagNet, archived as SYSMON.ZIP.

From the user's point of view, SYSMON is just a resizable window containing scrollable text, with three choices available on the menu bar. The first two menu bar items are pop-ups: the File menu, which lets the user activate the About... dialog box or exit the application; and the Display menu, which allows the user to select a display of the task list, module list, window class list, or global heap. (Users with really big screens also have the option of loading four different copies of the program at the same time and having each one display different information.) The third menu item is Refresh!, which simply forces the program to rewalk the currently selected system list and rebuild its output. The observant user will note that SYSMON also automatically refreshes its display every 10 seconds when it doesn't have the input focus, and that it "remembers" its most recent window size and position from one invocation to the next. The screen shot in Figure 3 shows SYSMON in action.

At the source-code level, SYSMON is based on the same table-driven approach to message handling that I showed in the DLGDEMO and BADAPP programs. This scheme facilitates the use of short, reusable routines rather than the lengthy, convoluted case statements generally found in Windows programming books, and I've found that it significantly shortens and simplifies both the coding and debugging phases of writing a new Windows

type into the application's header file. The previously existing (and presumably correct) application source code does not need to be changed at all.

As far as the ToolHelp aspects of SYSMON are concerned, the four routines to study are WalkClassList(), WalkTaskList(), WalkModuleList(), and WalkGlobalHeap(). These illustrate calls to the xxxFirst() and xxxNext() functions listed in Figure 1, along with their respective data structures. In order to keep the code in these functions easy to understand, I've kept the processing of the data structures rather simple, but you can quickly enhance the functions to format the information in the data structures more completely and more elaborately.

Aside from its interface with TOOLHELP.DLL, SYSMON's source code has several other interesting features you may wish to incorporate into your own programs. The first is SYSMON's capability to recall where it was last located on the screen. This feature turns out to be quite easy to implement, considering the huge difference in friendliness it projects to the user. You just use the functions GetWindowRect() and WritePrivateProfileString() to determine the window coordinates at application termination time and write them into an application-specific .INI file, then use GetPrivateProfileInt() and MoveWindow() to retrieve the coordinates from the .INI file and size and position the window at application initialization time. The SYSMON source code that handles this can be found in the routines UpdateProfile() and InitInstance(), respectively.

The next feature that is especially worth mentioning is the periodic refresh of the display, which is also easy to implement. A thunk for the timer callback function is allocated in InitInstance() with a call to MakeProcInstance(), and then a Windows system timer is activated and its interval specified with a call to SetTimer(). Windows subsequently enters the timer callback function, named TimerProc(), at 10-second intervals—irrespective of what other application might be in the foreground. The callback function first checks whether SYSMON's window is iconized or has the input focus; if neither condition is the case, the callback function just calls SendMessage() to send an IDM_REFRESH message to

The ToolHelp Voyeur Functions

Information type	Walk API	Specific object API	Data structure
Window classes	ClassFirst()	GetClassInfo()	CLASSENTY
	ClassNext()		
Active modules	ModuleFirst()	ModuleFindHandle()	MODULEENTRY
	ModuleNext()	ModuleFindName()	
Active tasks	TaskFirst()	TaskFindHandle()	TASKENTRY
	TaskNext()		
Global heap	GlobalFirst()	GlobalInfo()	GLOBALENTY
	GlobalNext()	GlobalEntryHandle()	
	GlobalEntryModule()		

Figure 1: These functions fall into two categories: those that allow you to "walk" through one of the system's linked lists of data objects, and those that let you retrieve information about a specific data object.


```

wc.style = CS_VREDRAW|CS_WREDRAW; // class style
wc.lpfWndProc = FrameWndProc; // class callback function
wc.cbClsExtra = 0; // extra per-class data
wc.cbWndExtra = 0; // extra per-window data
wc.hInstance = hInstance; // handle of class owner
wc.hIcon = LoadIcon(hInst, "SysMonIcon"); // application icon
wc.hCursor = LoadCursor(NULL, IDC_ARROW); // default cursor
wc.hbrBackground = GetStockObject(WHITE_BRUSH); // background color
wc.lpszMenuName = szMenuName; // name of menu resource
wc.lpszClassName = szFrameClass; // name of window class

return(RegisterClass(&wc)); // register frame window class

}

//
// InitInstance --- instance initialization code for this application.
//
BOOL InitInstance(HANDLE hInstance, int nCmdShow)
{
    HDC hdc; // handle for device context
    TEXTMETRIC tm; // info about font
    RECT rect; // window position & size
    int i; // scratch variable

    for(i = 0; i < MAXLINES; i++) // initialize all line
        LinePtr[i] = NULL; // pointers

    hFrame = CreateWindow( // create frame window
        szFrameClass, // window class name
        szAppName, // text for title bar
        WS_OVERLAPPEDWINDOW | WS_VSCROLL, // window style
        CW_USEDEFAULT, CW_USEDEFAULT, // default position
        CW_USEDEFAULT, CW_USEDEFAULT, // default size
        NULL, // no parent window
        NULL, // use class default menu
        hInstance, // window owner
        NULL); // unused pointer

    if(!hFrame) return(FALSE); // error, can't create window

    hdc = GetDC(hFrame); // get device context
    hFont = GetStockObject(SYSTEM_FIXED_FONT); // handle for nonprop. font
    SelectObject(hdc, hFont); // realize the font and get
    GetTextMetrics(hdc, &tm); // the character dimensions
    CharX = tm.tmAveCharWidth;
    CharY = tm.tmHeight + tm.tmExternalLeading;
    ReleaseDC(hFrame, hdc); // release device context

    GetWindowRect(hFrame, &rect); // current window pos & size

    // read profile for frame window from previous invocation, if any
    rect.left = GetPrivateProfileInt("Frame", "xul", rect.left, szIni);
    rect.top = GetPrivateProfileInt("Frame", "yul", rect.top, szIni);
    rect.right = GetPrivateProfileInt("Frame", "xlr", rect.right, szIni);
    rect.bottom = GetPrivateProfileInt("Frame", "ylr", rect.bottom, szIni);

    MoveWindow(hFrame, rect.left, rect.top, // force window size & position
        rect.right-rect.left, rect.bottom-rect.top, TRUE);

    // get display type from previous invocation, default to module list
    DisplayType = GetPrivateProfileInt("Frame", "type", IDM_MODULE, szIni);

    ShowWindow(hFrame, nCmdShow); // make frame window visible
    UpdateWindow(hFrame); // force WM_PAINT message
    SendMessage(hFrame, WM_COMMAND, DisplayType, 0); // initialize display

    // allocate thunk for timer callback routine
    lpTimerProc = MakeProcInstance((WNDPROC) TimerProc, hInst);

    // set up our 10 sec. (10,000 msec) timer callback
    if (!SetTimer(hFrame, 1, 10000, lpTimerProc))
        return(FALSE);

    return(TRUE); // return success flag

}

//
// TermInstance -- instance termination code for this application.
// Does nothing in this case, included for symmetry with InitInstance.
//
BOOL TermInstance(HANDLE hInstance)
{
    return(TRUE); // return success flag

}

//
// FrameWndProc --- callback function for application frame window.
// Searches frameMsgs[] for message match, runs corresponding function.
//
LONG FAR APIENTRY FrameWndProc(HWND hWnd, UINT wParam, LRESULT lParam)
{
    int i; // scratch variable

    for(i = 0; i < dim(frameMsgs); i++) // decode window message and
    { // run corresponding function
        if(wParam == frameMsgs[i].Code)
            return((LRESULT) frameMsgs[i].Pfn(hWnd, wParam, lParam));
    }
}

```

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```
    return(DefWindowProc(hWnd, wParam, lParam));
}

//
// DoCommand -- process WM_COMMAND message for frame window by
// decoding the menu bar item with the menuitems[] array, then
// running the corresponding function to process the command.
//
LONG DoCommand(HWND hWnd, UINT wParam, LONG lParam)
{
    int i;                // scratch variable

    for(i = 0; i < dim(menuitems); i++) // decode menu command and
    {                                  // run corresponding function
        if(wParam == menuitems[i].Code)
            return(menuitems[i].Fxn(hWnd, wParam, lParam));
    }

    return(DefWindowProc(hWnd, wParam, lParam));
}

//
// DoDestroy -- process WM_DESTROY message for frame window.
//
LONG DoDestroy(HWND hWnd, UINT wParam, LONG lParam)
{
    PostQuitMessage(0); // force WM_QUIT message to
    return(0);          // terminate the event loop
}

//
// DoClose -- process WM_CLOSE message for frame window.
//
LONG DoClose(HWND hWnd, UINT wParam, LONG lParam)
{
    UpdateProfile(); // save window size & position
    DestroyWindow(hWnd); // then close down app
    return(FALSE);
}

//
// DoVScroll -- process WM_VSCROLL message for frame window.
//
LONG DoVScroll(HWND hWnd, UINT wParam, LONG lParam)
{
    RECT rect;

    switch(LOWORD(wParam)) // LOWORD vital for Win32
    {
        case SB_TOP: // go to top of output if
        {             // we aren't there already
            SetCurLine(0);
            Repaint();
        }
        break;

        case SB_BOTTOM: // go to bottom of output if
        {                // we aren't there already
            SetCurLine(TopLine);
            Repaint();
        }
        break;

        case SB_LINEUP: // scroll up by one line if
        {               // we aren't already at top
            SetCurLine(CurLine - 1);
            ScrollWindow(hWnd, 0, CharY, NULL, NULL);
            UpdateWindow(hWnd);
        }
        break;

        case SB_LINEDOWN: // scroll down by one line if
        {                 // we aren't already at bottom
            SetCurLine(CurLine + 1);
            ScrollWindow(hWnd, 0, -CharY, NULL, NULL);
            GetClientRect(hWnd, &rect);
            rect.top = max(0, (LinesPerPage-1) * CharY);
            InvalidateRect(hWnd, &rect, TRUE);
            UpdateWindow(hWnd);
        }
        break;

        case SB_PAGEUP: // scroll up by one page
        {
            SetCurLine(CurLine - LinesPerPage);
            Repaint();
        }
        break;

        case SB_PAGEDOWN: // scroll down by one page
        {
            SetCurLine(CurLine + LinesPerPage);
            Repaint();
        }
        break;

        case SB_THUMBPOSITION: // scroll display according
    }

    SetCurLine(THUMBPOS); // to new thumb position
    Repaint();
    break;
}

return(FALSE);

//
// DoPaint -- process WM_PAINT message for frame window.
//
LONG DoPaint(HWND hWnd, UINT wParam, LONG lParam)
{
    HDC hdc;
    PAINTSTRUCT ps;
    int i;

    hdc = BeginPaint(hWnd, &ps); // get device context
    SelectObject(hdc, hFont); // select non-prop. font

    for(i = 0; i < LinesPerPage; i++) // paint lines of text
    {                                  // in the window
        PaintLine(hdc, i);
    }

    EndPaint(hWnd, &ps); // release device context
    return(FALSE);
}

//
// DoSize -- process WM_SIZE message for frame window.
//
LONG DoSize(HWND hWnd, UINT wParam, LONG lParam)
{
    LinesPerPage = HIWORD(lParam) / CharY; // window height / char height
    ConfigWindow(); // calc display parameters
    if(CurLine > TopLine) // make sure window refilled
    {
        SetCurLine(TopLine); // if window got bigger
    }
    return(0);
}

//
// DoMenuExit -- process File-Exit command from menu bar.
//
LONG DoMenuExit(HWND hWnd, UINT wParam, LONG lParam)
{
    SendMessage(hWnd, WM_CLOSE, 0, 0); // send window close message
    return(FALSE); // to shut down the app
}

//
// DoDisplayType -- process items on Display popup to select
// the type of information to display, then force window update
//
LONG DoDisplayType(HWND hWnd, UINT wParam, LONG lParam)
{
    HMENU hMenu; // scratch menu handle

    hMenu = GetMenu(hWnd); // update popup checkmark
    CheckMenuItem(hMenu, DisplayType, MF_UNCHECKED);
    DisplayType = wParam;
    CheckMenuItem(hMenu, DisplayType, MF_CHECKED);
    SendMessage(hWnd, WM_COMMAND, IDM_REFRESH, 0); // update window
    return(FALSE);
}

//
// DoRefresh -- rebuild the information for display according to
// the currently selected display type, then refresh the window.
//
LONG DoRefresh(HWND hWnd, UINT wParam, LONG lParam)
{
    EmptyLines(); // discard previous output

    switch(DisplayType) // call the appropriate
    {                   // list walking routine
        case IDM_MODULE: // according to display type
        {
            WalkModuleList();
            SetWindowCaption("Modules");
            break;

            case IDM_CLASS:
            {
                WalkClassList();
                SetWindowCaption("Window Classes");
                break;

                case IDM_TASK:
                {
                    WalkTaskList();
                    SetWindowCaption("Active Tasks");
                    break;

                    case IDM_HEAP:
                    {
                        WalkGlobalHeap();
                        SetWindowCaption("Global Heap");
                        break;
                    }
                }
            }
        }

        ConfigWindow(); // configure scroll bar etc.
        Repaint(); // refresh the window

    }
    return(FALSE);
}
```


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```
}

//
// DoMenuAbout -- process File-About command from menu bar.
//
LONG DoMenuAbout(HWND hWnd, UINT wParam, LONG lParam)
{
    WNDPROC lpAboutProc;           // scratch far pointer

    // allocate a thunk for the dialog callback, then display dialog
    lpAboutProc = MakeProcInstance((WNDPROC)AboutDlgProc, hWnd);
    DialogBox(hWnd, "AboutBox", hWnd, lpAboutProc);
    FreeProcInstance(lpAboutProc);
    return(FALSE);
}

//
// AboutDlgProc -- callback routine for About... dialog. Basically
// ignores all messages except for the OK button, which dismisses dialog.
//
BOOL FAR APIENTRY AboutDlgProc (HWND hWnd, UINT msg, UINT wParam, LONG lParam)
{
    if((msg == WM_COMMAND) && (wParam == IDOK))
        EndDialog(hWnd, 0);        // if OK button, destroy dialog
    else return(FALSE);            // otherwise ignore message
}

//
// WalkModuleList -- uses ToolHelp functions to walk through
// module list and build formatted output in LinePtr[] array.
//
VOID WalkModuleList(VOID)
{
    MODULEENTRY me;                // receives module info
    char temp[256];                // scratch formatting buffer

    memset(&me, 0, sizeof(MODULEENTRY)); // initialize structure for
    me.dwSize = sizeof(MODULEENTRY); // return of module data
    AddLine("Handle Usage Module Pathname"); // format title
    ModuleFirst(&me);              // initialize to 1st module

    do {
        // format module information
        wprintf(temp, "%04Xh %4d %-8.8s %s", me.hModule, me.wcUsage,
            (LPSTR) me.szModule, (LPSTR) me.szExePath);
        AddLine(temp);             // add to array for output
    } while(ModuleNext(&me));      // get next module name
}

//
// WalkClassList -- uses ToolHelp functions to walk through
// window class list and build formatted output in LinePtr[] array.
//
VOID WalkClassList(VOID)
{
    CLASSENTRY ce;                // receives window class info
    char temp[256];                // scratch formatting buffer

    memset(&ce, 0, sizeof(CLASSENTRY)); // initialize structure for
    ce.dwSize = sizeof(CLASSENTRY); // return of window class data
    AddLine("Owner Class Name"); // format title
    ClassFirst(&ce);              // initialize to 1st class

    do {
        // format owner & classname
        wprintf(temp, "%04Xh %s", ce.hInst, (LPSTR) ce.szClassName);
        AddLine(temp);             // add to array for output
    } while(ClassNext(&ce));      // get next class name
}

//
// WalkTaskList -- uses ToolHelp functions to walk through
// task list and build formatted output in LinePtr[] array.
//
VOID WalkTaskList(VOID)
{
    TASKENTRY te;                // receives task info
    MODULEENTRY me;              // receives module info
    char temp[256];                // scratch formatting buffer

    memset(&te, 0, sizeof(TASKENTRY)); // initialize structure for
    te.dwSize = sizeof(TASKENTRY); // return of task info
    memset(&me, 0, sizeof(MODULEENTRY)); // initialize structure for
    me.dwSize = sizeof(MODULEENTRY); // return of module data
    AddLine("Task Parent Instance Module Module Module");
    AddLine("Handle Task Handle Handle Name Pathname");
    TaskFirst(&te);              // initialize to 1st task

    do {
        // format task information
        ModuleFindHandle(&me, te.hModule); // get modulename & pathname
        wprintf(temp, "%04Xh %04Xh %04Xh %04Xh %-8.8s %s",
            te.hTask, te.hTaskParent, te.hInst, te.hModule,
            (LPSTR) me.szModule, (LPSTR) me.szExePath);
        AddLine(temp);             // add to array for output
    } while(TaskNext(&te));      // get next task
}

//
// WalkGlobalHeap -- uses ToolHelp functions to walk through
// global heap and build formatted output in LinePtr[] array.
//
VOID WalkGlobalHeap(VOID)
{
    GLOBALENTY ge;                // receives heap block info
    TASKENTRY te;                // receives task info
    MODULEENTRY me;              // receives module info
    char temp[256];                // scratch formatting buffer

    memset(&ge, 0, sizeof(GLOBALENTY)); // initialize structure for
    ge.dwSize = sizeof(GLOBALENTY); // return of heap block info
    memset(&me, 0, sizeof(MODULEENTRY)); // initialize structure for
    me.dwSize = sizeof(MODULEENTRY); // return of module data
    memset(&te, 0, sizeof(TASKENTRY)); // initialize structure for
    te.dwSize = sizeof(TASKENTRY); // return of task info
    AddLine("Handle Linear Addr Size Type Owner"); // format title
    GlobalFirst(&ge, GLOBAL_ALL); // initialize to 1st block

    do {
        // format heap block info
        if(TaskFindHandle(&te, ge.hOwner)) // get owner's name
            ModuleFindHandle(&me, te.hModule);
        else if(!ModuleFindHandle(&me, ge.hOwner))
            me.szModule[0] = '\0';
        wprintf(temp, "%04Xh %08lXh %08lXh %04Xh %04Xh %s",
            ge.hBlock, ge.dwAddress, ge.dwBlockSize, ge.wType,
            ge.hOwner, (LPSTR) me.szModule);
        AddLine(temp);             // add to array for output
    } while(GlobalNext(&ge, GLOBAL_ALL)); // get next class name
}

//
// SetCurLine -- called to set CurLine to valid value, clamped to
// the range (0...TopLine), and redraw thumb on scrollbar.
//
VOID SetCurLine(int NewLine)
{
    CurLine = min(max(NewLine, 0), TopLine);
    SetScrollPos(hFrame, SB_VERT, CurLine, TRUE);
}

//
// ConfigWindow -- Configures various display parameters and scrollbar
// according to total lines of output, current window size, and the
// number of lines that will fit into the window.
//
VOID ConfigWindow(VOID)
{
    // calc line number of first line of last page
    TopLine = max(TotLines - LinesPerPage, 0);

    // update scrollbar range and thumb position
    SetScrollRange(hFrame, SB_VERT, 0, TopLine, FALSE);
    SetScrollPos(hFrame, SB_VERT, CurLine, TRUE);
}

//
// AddLine -- called with a pointer to an ASCII2 string, allocates
// memory from the heap to hold the string, puts the pointer
// to the heap block into the next position in the LinePtr[] array,
// and updates the total line count.
//
VOID AddLine(char * p)
{
    char * q;                     // scratch pointer

    if(TotLines == MAXLINES)
        return;                   // bail out if line pointer *
    // array is already full
    q = malloc(strlen(p)+1);      // allocate memory for line
    if(q == 0)                    // bail out if no
        return;                   // heap space available
    strcpy(q, p);                 // copy string to heap
    LinePtr[TotLines] = q;        // put heap pointer into array
    TotLines++;                   // count lines of output
}

//
// EmptyLines -- releases all heap blocks in LinePtr[] array.
// then zeros out the line pointers and the total line count
//
VOID EmptyLines(VOID)
{
    int i;                         // scratch variable

    for(i = 0; i < MAXLINES; i++)
    {
        if(LinePtr[i])            // if this position in
            free(LinePtr[i]);      // the LinePtr array is
        LinePtr[i] = NULL;         // nonzero, release the
    }                               // heap block, then zero
    // out the LinePtr slot

    CurLine = 0;                  // initialize various
    TotLines = 0;                 // other global variables
    TopLine = 0;

    //
    // PaintLine -- paint a single line of text in the window.

```


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```
// The passed line number is relative to the window, NOT to the
// total array of formatted output available to be painted.
//
VOID PaintLine(HDC hdc, INT RelLine)
{
    int Line = RelLine + CurLine;
    if (LinePtr[Line])
        TextOut(hdc, 0, RelLine*CharY, LinePtr[Line], strlen(LinePtr[Line]));
}

//
// Repaint - force repaint of all formatted output in main window
//
VOID Repaint(VOID)
{
    InvalidateRect(hFrame, NULL, TRUE); // force repaint entire window
}

//
// SetWindowCaption -- concatenate the application name with the
// display type, then update the frame window's title bar.
//
VOID SetWindowCaption(char * szDisplayType)
{
    char szTemp[256]; // scratch buffer

    strcpy(szTemp, szAppName); // get application name
    strcat(szTemp, " - "); // add separator
    strcat(szTemp, szDisplayType); // add information type
    SetWindowText(hFrame, szTemp); // put result into title bar
}

//
// UpdateProfile() -- saves the current window size and position
// and display type in the application's private INI file.
//
VOID UpdateProfile(VOID)
```

```
{
    RECT rect;
    char temp[20];

    if (IsIconic(hFrame) || IsZoomed(hFrame)) return;

    GetWindowRect(hFrame, &rect);

    wprintf(temp, "%d", rect.left);
    WritePrivateProfileString("Frame", "xul", temp, szIni);

    wprintf(temp, "%d", rect.top);
    WritePrivateProfileString("Frame", "yul", temp, szIni);

    wprintf(temp, "%d", rect.right);
    WritePrivateProfileString("Frame", "xlr", temp, szIni);

    wprintf(temp, "%d", rect.bottom);
    WritePrivateProfileString("Frame", "ylr", temp, szIni);

    wprintf(temp, "%d", DisplayType);
    WritePrivateProfileString("Frame", "type", temp, szIni);
}

//
// TimerProc() -- Callback for 10 second timer. Refresh display
// if window is not minimized and does not have the focus.
//
WORD FAR APIENTRY TimerProc(HWND hwnd, WORD message, WORD wParam, LONG lParam)
{
    if (!IsIconic(hFrame) && (hFrame != GetFocus()))
        SendMessage(hFrame, WM_COMMAND, IDM_REFRESH, 0);
    return(FALSE);
}
```

SYSMON's frame window—and the message is handled exactly as though the user had clicked the Refresh! item on the menu bar. This is a potent example of how exploitation of Windows' event-driven, message-based architecture can simplify application design.

The third (and perhaps most novel) characteristic of SYSMON's source code I'd like to bring to your attention is the handling of the text displayed in the main window. If you try to integrate the painting of text and the control of the scrollbar's range and thumb position with the code that actually walks the system lists, you get a real mess. There's no way to predict how many items will be found in a list in advance, and this may change

from one walk of the list to another, making scrolling the display backwards and forwards and maintenance of the scrollbar itself a messy proposition. The solution is to completely divorce the code that generates the text to be displayed from the code that actually paints the text in the window. The two bodies of code communicate via an array of pointers called LinePtrs[]. Each slot in LinePtrs[] corresponds to a line of text to be displayed and either contains a pointer to an ASCIIZ string or a NULL pointer if the line is empty.

The central routines that format information for display—that is, the four routines WalkClassList(), WalkTaskList(), WalkModuleList(), and WalkGlobal-

Heap()—initialize the display (from their point of view) by calling EmptyLines(), and place text on the display by repeatedly calling AddLine(). But what EmptyLines() actually does is just zero out LinePtrs[] and the count of the lines to be displayed, while AddLine() merely allocates some heap space to hold the string that is passed to it, puts a pointer to the heap block into LinePtrs[], and increments the line count. After a list-walking

routine is done with its work, it calls ConfigWindow(), which calculates the line number of the first line in the last display page (if there is enough text that scrolling will be required) and configures or hides the scrollbar.

Which routine takes text out of LinePtrs[] and paints it in the SYSMON window? Why, DoPaint(), naturally, which is called whenever the application receives a WM_PAINT message. DoPaint() can behave as though the contents of LinePtrs[] are static, and it gets the total number of lines of text from the variable TotLines, the number of the first line to be displayed in the window from the variable CurLine, and the number of lines that the window can hold from the variable LinesPerPage. The message-handler routine for scrollbar messages, DoVScroll(), needs to do little more than manipulate the variable CurLine and send a WM_PAINT message to the SYSMON window. At that point, the display logic degenerates to mindless bookkeeping, which is certainly a curious event in Windows programming.

THE IN-BOX Please send your questions, comments, and suggestions to me at any of these electronic mail addresses: PC MagNet: 72241,52 MCI Mail: rduncan BIX: rduncan □

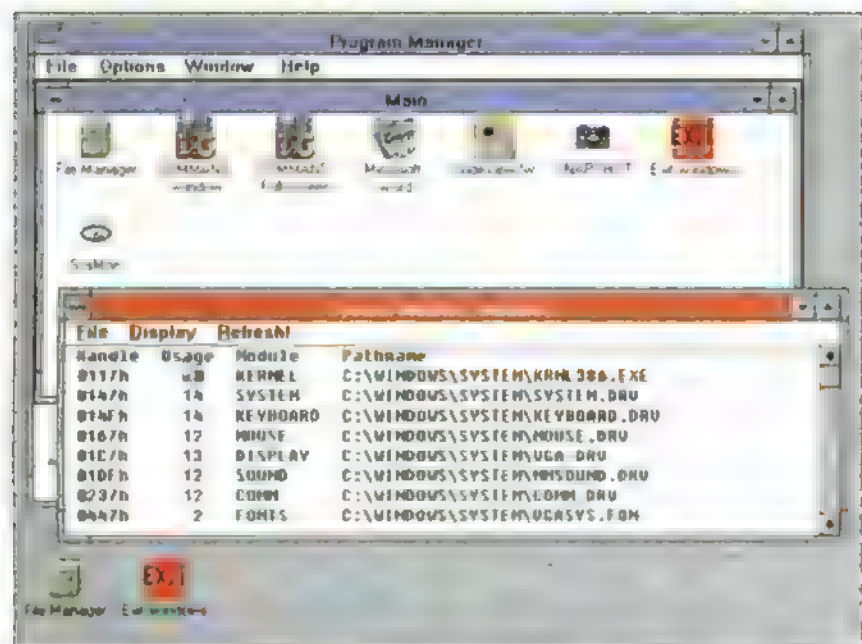


Figure 3: The SYSMON utility, with the task list display selected.

FoxPro's Prompt Files List Box: How to get a fully qualified filename from FoxPro's Prompt Files list box

BY SAL RICCIARDI

FoxPro's Prompt Files List Box

One of the best features of the list object in the FoxPro 2.0 Screen Builder is that you can use the Prompt Files option to create a robust file-selection box. A user can then traverse all of the available drives and directories in search of a file that matches your mask.

Unfortunately, the variable returned by the list box does not indicate whether or not the user selected a file from another directory. All you get is the filename and extension. It's definitely not safe to assume that the selected file is in your current directory.

There is a solution, however. To get the full path of the selected file, you can use the PRMBAR() function. The function takes two parameters: the name (as a character string) of the pop-up definition used by the list, and the position number of the bar in the pop-up. In this case, the second argument will be 2, to give you the full path minus the filename itself. Using PRMBAR(), you can add a VALID snippet to obtain the pathspec using code like this:

```
STORE ;
PRMBAR( "_q3j0nb11s", 2 ) ;
TO pathspec
```

Note that the pop-up name here is one of the randomly generated names supplied by the screen-code generator. You can figure out what this name is by first generating the screen code and looking at the resulting .SPR file, but that's very risky. The next time you modify the screen, a new name will be generated, and you'll be asking PRMBAR() to process a pop-up that doesn't exist. Currently, there is no automatic way to determine the newly generated pop-up name for use with the PRMBAR() function.

You could bypass the Screen Builder and hard-code the pop-up, but why give up on the Screen Builder so easily? A better approach is to create a SETUP snippet to define a pop-up with a meaningful name:

```
DEFINE POPUP filepop ;
  PROMPT FILES LIKE *.EXE ;
  SCROLL ;
  MARGIN ;
  MARK ">"
```

Then change the list type in the Screen Builder from Prompt Files to From Popup, and set From Popup to your pop-up name, in this case filepop.

Finally, use filepop in place of the generated name in your VALID snippet call to PRMBAR(), as follows:

```
STORE ;
PRMBAR( "filepop", 2 ) ;
TO pathspec
```

With this approach, you don't have to worry about generated names being changed, and you can still use the Screen Builder productively.

*Robert Richardson
Norwell, Massachusetts*

► **PC MAGAZINE** FoxPro's Screen Builder lets you create a scrollable list from several possible sources. The choices are From Array, From Popup, Prompt Structure, Prompt Field, and Prompt Files. As you can probably tell from their names, the first and second options create the list from an existing named array or from a named pop-up, respectively. The third option, Prompt Structure, places database field names into the list. The fourth, Prompt Field, lets you specify a field name whose column contents will be placed into the list. And finally, Prompt

Files lets you fill the list with filenames that match a file specification.

When you choose the Prompt Files option, FoxPro's GENSCRN code generator creates code to first define a file-selection pop-up and then create the scrollable list from the pop-up. For example, if you examine the generated .SPR file, you'll find code similar to that shown below:

```
DEFINE POPUP _q4h0ukspy ;
  PROMPT FILES LIKE *.* ;
  SCROLL ;
  MARGIN ;
  MARK ">"

@ 2,30 GET cFilename ;
  PICTURE "@t" ;
  POPUP _q4h0ukspy ;
  SIZE 21,21 ;
  DEFAULT " "
```

You'll note that the DEFINE POPUP statement creates a pop-up named _q4h0ukspy, and the @.GET statement follows by using the clause POPUP _q4h0ukspy to create a scrollable list from the pop-up. This isn't all that different from defining the pop-up yourself in the SETUP snippet and choosing From Popup instead of Prompt Files. The main difference is that, using Prompt Files, FoxPro generates object names automatically (those funny looking names like _q4h0ukspy). Using From Popup, it's up to you to name the pop-up and define it correctly in the SETUP snippet.

Of course, defining it yourself has the added benefit that, since you'll know the pop-up's name, you can use it in calls to functions like PRMBAR(). As Mr. Richardson points out, PRMBAR() can be particularly handy with file-selection list pop-ups.

Figure 1 shows a file-selection list

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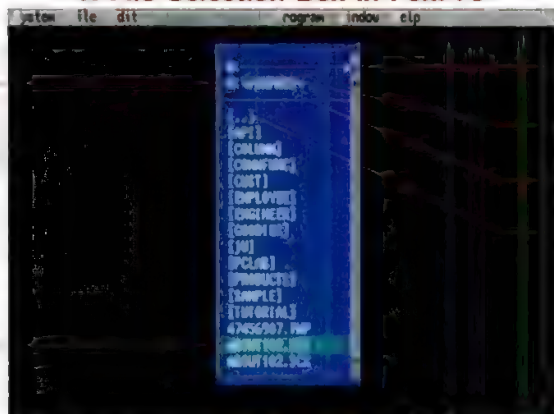
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A File Selection Box in FoxPro

PRMBAR("filepop",2)
returns "H:\FOXPRO2"

Filename returned is
"ABOUT102.SCT"



Bar 1 "H:"

Bar 2 "H:\FOXPRO2"

Bar 3 "

Bar 4 "L:"

Figure 1: A file-selection list created by first defining a file-selection pop-up in the SETUP snippet and then using From Popup as the list type.

created by first defining a file-selection pop-up in the SETUP snippet and then using From Popup as the list type. When you move about in such a list, the second line in the list always contains the current working drive and directory. FoxPro updates this line automatically, so if you navigate to a different drive or directory, it will always be reflected in the second line of the pop-up.

Each line in the pop-up is called a *bar* and is numbered sequentially starting with 1. You can use the PRMBAR() function to obtain the contents of any bar as long as you know the name of the pop-up and the bar number. Since the drive and directory are always kept current in bar number 2, you can use

```
cFullfile = ;
PRMBAR( "filepop", 2) ;
+ cFilename
```

where cFilename is the list-box variable.

Note that the list-box VALID routine is *not* called if you simply tab into and out of the list box, or use the Arrow keys to navigate within the list box without making a selection. The VALID is only called when a selection is explicitly made.

Also note that the list-box variable is updated constantly with every movement within the list box. Therefore, the only time the list-box variable accurately reflects an explicit selection is when the list-box VALID routine is called.

Using FoxPro's scrollable list object to present a file-selection list is useful when you want to construct a custom dialog box or when you want the file-selection list to participate in an active READ. If neither of these uses suits your needs, you may find the GETFILE() function more appropriate. It can be used to present FoxPro's own Open File dialog, and it returns a fully qualified filename. □

```
PRMBAR( "filepop", 2)
```

to extract the path specification. Then, constructing a fully qualified filename becomes a simple matter of combining the pathspec with the list variable, providing you do this in the right place. But where is the right place?

To make a selection in a scrollable list, you move the highlight bar to an item and press the Enter key; or you move the mouse cursor to the item and double-click using the left mouse button. Either way, the VALID routine for the scrollable list is called right after you do this. This VALID clause is the best place to construct a fully qualified filename, since it is the only code that is called exclusively when an item in the list box is *chosen*.

For example, your VALID routine might contain the following:

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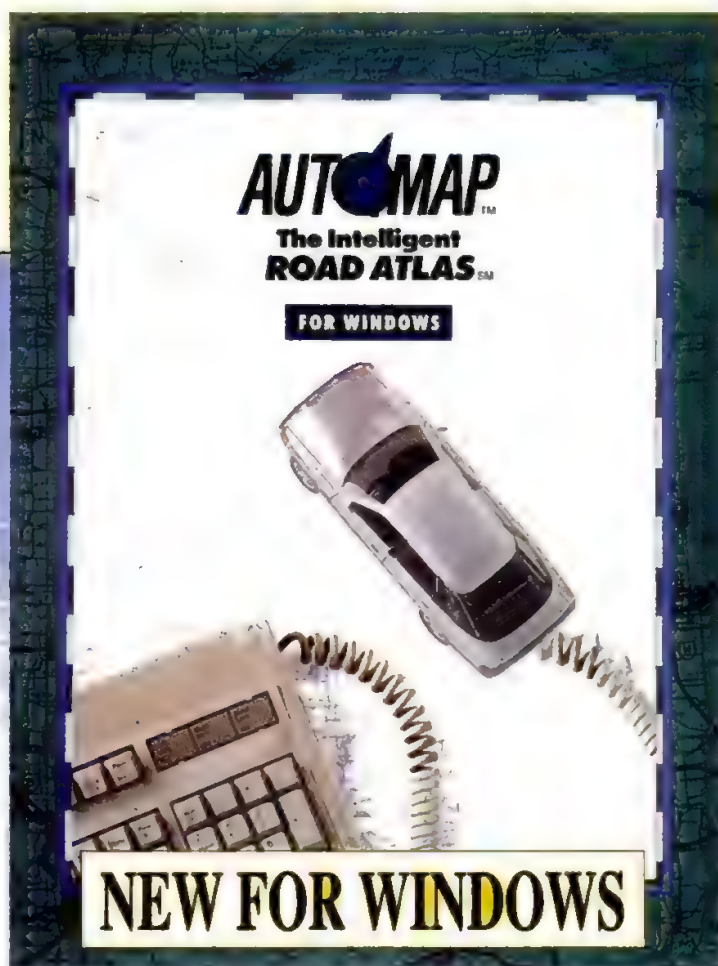
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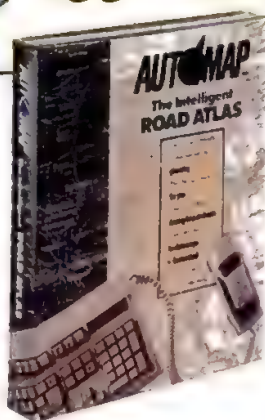
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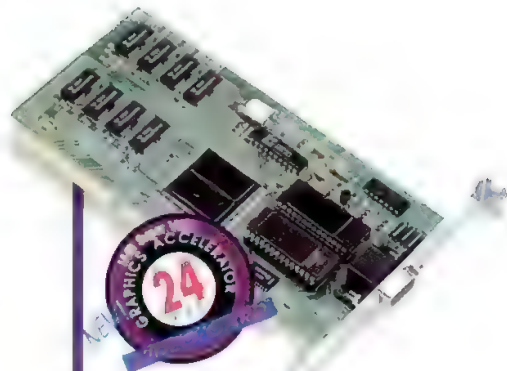
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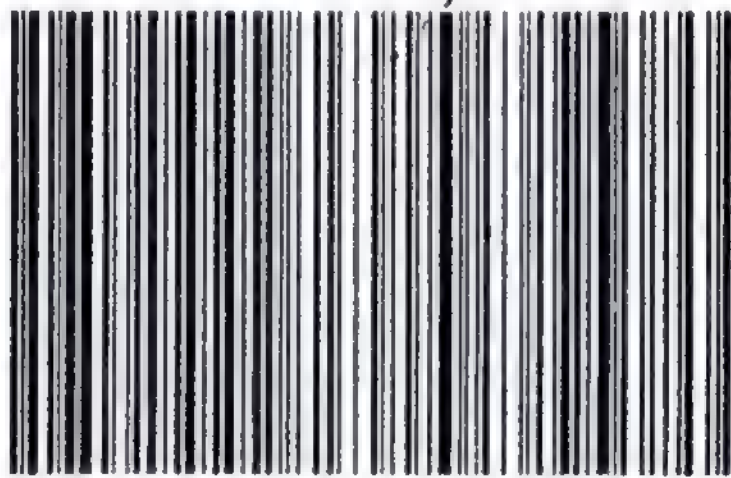
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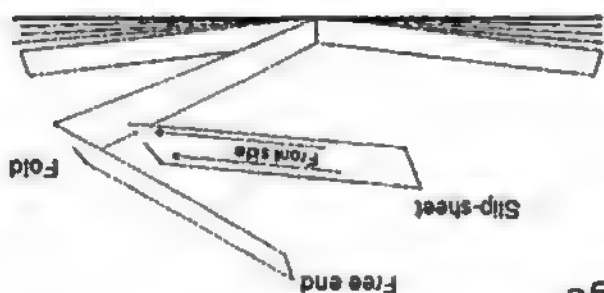


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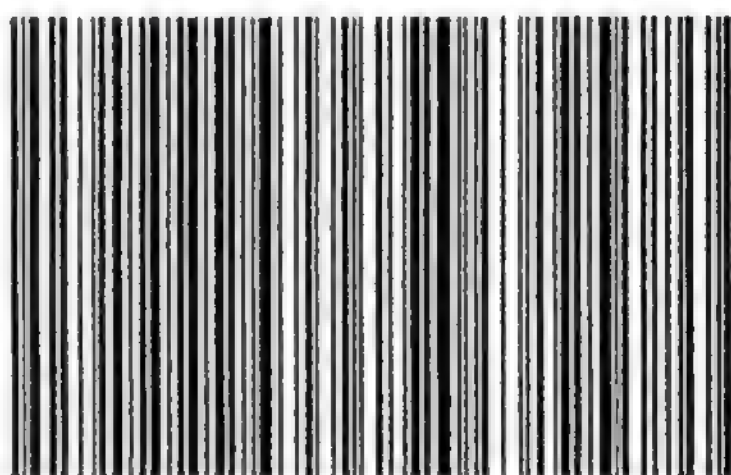
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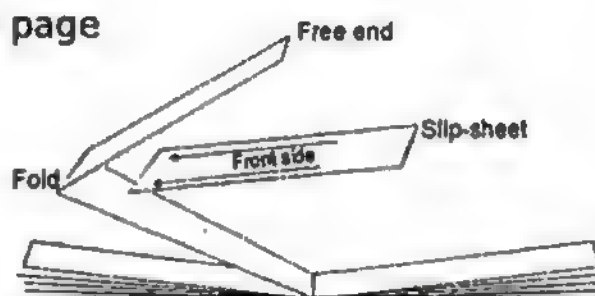


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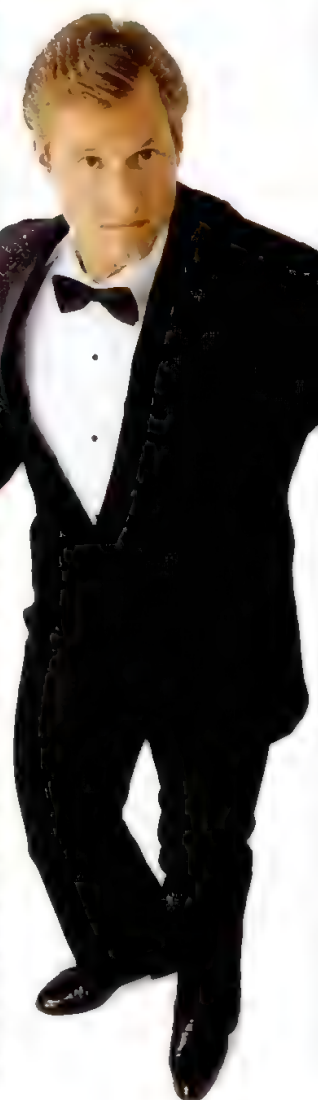
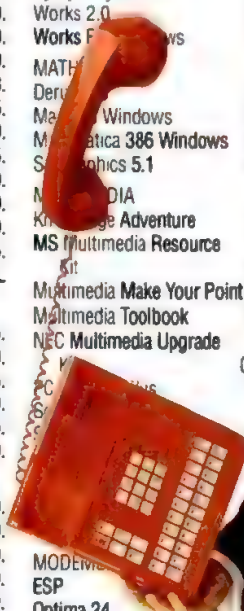
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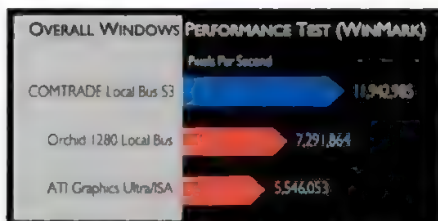
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Source: COMTRADE/COMPR, July 92, Local Bus Video Review, Page 184



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Learning the Basics: Teaching beginners the computer industry's buzzwords **Memory Managers on a 486:** Does a 486 system benefit from a 386 memory manager?

BY JOE SALEM I

PCs for the Visually Impaired

I am looking for a personal computing system that could be used by blind people. As far as I know, such systems do not exist in Brazil.

Marcelo Turrin
Sao Paulo, Brazil

► **PC MAGAZINE** No one company makes a complete system for the visually impaired, but a number of companies in the United States make system add-ons such as Braille keyboards, Braille printers, and speech systems.

HumanWare Inc. (6245 King Rd., Loomis, CA 95650; 800-722-3393, 916-652-7253) sells the KeyBraille Braille reader (\$6,995), which translates the screen output line-by-line to Braille through a strip of pins that raise and lower to represent each character. It attaches to MS-DOS systems through the parallel port and includes extra Braille cells to update the user on the cursor's position. HumanWare also offers the Keynote processor board (\$1,875 for the serial port version, \$1,545 for the internal ISA board), which converts information on the screen into speech.

Another maker of peripherals for the visually impaired is TeleSensory (455 N. Bernardo Ave., P.O. Box 7455, Mountain View, CA 94039-7455; 415-960-0920). The Navigator D, a Braille output system for desktop computers, comes in three versions: 6 dot/20 cell for \$4,595, 6 dot/40 cell for \$5,995, and 8 dot/40 cell for \$6,695. If you want a full 8 dot/80 character Braille display, there's the Navigator 80, which sells for \$12,995.

TeleSensory's VersaPoint Braille Embosser (\$3,795) is a Braille printer (40 characters per second) that supports both

text and graphics and works with most personal computers. The VersaPoint is also available with either the Duxbury Braille translation software (for MS-DOS and Macintosh systems) or Hot Dots Braille software (for MS-DOS systems). Both options sell for \$4,295. Other software options are also available.

Another line of products from Tele-

No one company makes a complete system for the visually impaired, but many companies do make a variety of system add-ons.

Sensory is the OsCaR Systems (for ISA- and MCA-compatible systems), which combine a scanner to input text-based documents with software that converts them to both screen representations and Braille output. Prices range from \$595 for just the software to \$4,295 for a complete system that includes an HP ScanJet Plus scanner and a Braille translation program.

Finally, TeleSensory sells speech synthesizer boards, including the Vert Plus for ISA bus systems (\$1,995). The Vert Plus also comes in Spanish or German

versions (\$2,095 each). The Personal Vert, a less expensive version with a smaller vocabulary, sells for \$995. The Soft Vert series is available in a software-only version for use with any speech board (\$495), is sold with an internal board for Toshiba 1200 systems (\$1,095), or is sold with an external synthesizer for any MS-DOS computer (\$1,495). The outSPOKEN software provides speech for Macintosh computers (\$395) using the Mac's internal speech synthesizer.

Artic Technologies International (55 Park St., Troy, MI 48083-2753; 313-588-7370) also makes speech boards that work with a wide variety of IBM-compatible systems. Among the company's many products are the SynPhonix 215 (\$795) for ISA bus-based systems, the SynPhonix 225 (\$895) for Toshiba laptop systems, and the SynPhonix MicroChannel 315 (\$995) for MCA bus-based systems. The boards are bundled with Artic Vision software, which translates text-based screen info or keystrokes into speech. Optional Business Vision software, which extends the speech capabilities to spreadsheets, adds \$100 to the cost of the board.

Dragon Systems Inc. (320 Nevada St., Newton, MA 02160; 800-825-5897; 617-965-5200) sells DragonDictate (\$8,995), a speech-recognition system that requires a 386 machine or better with 8MB of RAM. DragonDictate is available for ISA and MCA systems.

Finally, Arkenstone Inc. (1185 Bordeaux Drive, Suite D, Sunnyvale, CA 94089; 800-444-4443, 408-752-2200) sells a series of OCR readers that range from the Reader II S/AT Plus (\$2,645) to the top-of-the-line Hot Reader AT Plus (\$3,845). All the systems come with an HP ScanJet Plus. A hand scanner to go

► IN THIS SECTION

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with it costs an additional \$895. Arkenstone also sells both systems with just the hand scanner (\$2,380 for the S/AT and \$3,590 for the HOT/AT). The system supports a number of speech boards and Braille output devices, including those mentioned above.

Learning the Basics

Although I have never operated a computer, I have recently become interested in learning about the field. My problem is that when I talk to people about the subject, they answer me in computer jargon and I walk away more confused than when I approached them. I've gone to bookstores to find a glossary of terms, but these books seem to cater to people already versed in the field. Is there a book available to help the uninitiated?

Fred A. Banzer
Livermore, California

► **PC MAGAZINE** One of the best introductions to basic personal computer terms and concepts is *Inside the IBM PC & PS/2*, by Peter Norton (Brady Communications Co., G + W Bldg., One Gulf + Western Plaza, New York, NY 10023; \$24.95). Now in its fourth edition, the book summarizes the history of PCs and explains such concepts as what data is and how it's stored, and what personal computer hardware is (such as the disk drives and video system) and how it works. The book also covers the basics of using DOS.

Once you understand the basic concepts, you can move on to the numerous books that cover DOS, Windows, OS/2, and specific applications.

Memory Managers on a 486

How does QEMM-386, Version 6.0, perform on a 486/33 PC? Is it worthwhile to install it, or is it best used only on a 386? Are there any advantages for WordPerfect?

S. Witzgall
Amsterdam, Netherlands

► **PC MAGAZINE** The 486 CPU has the same memory management capabilities as the 386 chip, so any 386 memory manager will work just as well on a 486.

Memory managers such as QEMM-386 (QuarterDeck Office Systems Inc.,

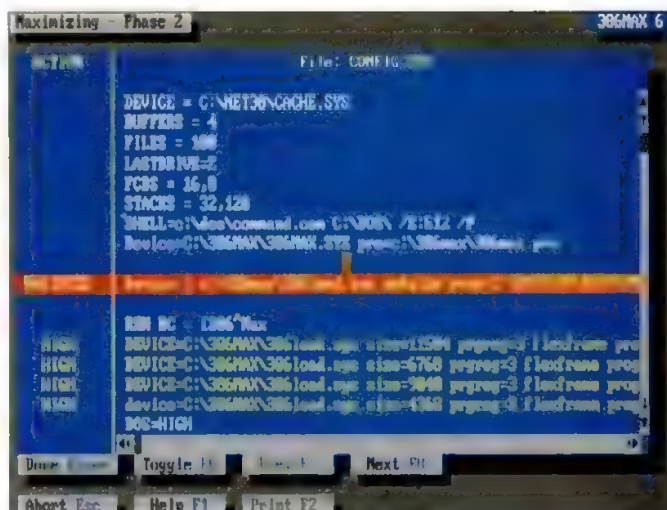
150 Pico Blvd., Santa Monica, CA 90405; 310-392-9851; \$99.95), 386-MAX (Qualitas Inc., 7101 Wisconsin Ave., #1386, Bethesda, MD 20814; 800-676-0386, 301-907-6700; \$99.95), and Netroom (Helix Software, 47-09 30th St., Long Island City, NY 11101; 800-451-0551, 718-392-3100; \$99.00) provide LIM 4.0 EMS (expanded) and XMS (extended memory specification) services for programs that can use them.

WordPerfect 5.1 is one such program; it uses EMS to load as much of its overlays as possible into memory, reducing the need for constant disk accesses.

Microsoft's DOS 5.0, Windows 3.0, and Windows 3.1, and Digital Research's DR DOS 6.0 all provide some 386/486 memory management functions, but they generally don't do it as well as the third-party products. The Microsoft products come with HIMEM.SYS and EMM-386.SYS, which provide access to UMBs (upper memory blocks) as well as the ability to load most of the DOS kernel into upper memory, leaving even more lower RAM free. Digital Research provides EMM386.SYS for 386 machines and HIDOS.SYS for 286s.

The third-party 386/486 memory managers mentioned here support DOS 5.0 specifications, so you can load the DOS kernel high with them by putting a DOS=HIGH statement in your CONFIG.SYS file. The biggest advantage a third-party 386/486 memory manager provides is easy access to UMBs for loading TSRs and device drivers high. (For an explanation of UMBs, see the Tutor column in the March 17, 1992, issue.) Memory managers provide utilities that check the amount of upper memory available and scan the memory-resident software for the best fit, letting you load more programs into the UMBs.

The second advantage these utilities have over DOS's memory management



One of the many features third-party 386/486 memory managers provide is a utility that scans your TSRs and device drivers to find the best fit into the UMB area. This screen shows Qualitas's 386MAX optimizer, called Maximize.

is that they let you interactively remap some of the unused system-BIOS and video-card memory areas to provide even more UMBs than DOS can.

Certainly, any of third-party 386 memory managers would be the perfect accessory for your DOS-based 80486 system. For more details on these and other 386 memory managers, see the review "The Well Tuned PC: A Guide to Memory Managers" that appears in this issue.

Updates

In the December 17, 1991, column, I mentioned some data-conversion companies that can convert data from a Brother system to the IBM PC format. I've since learned of another company that can handle this type of conversion as well as many others: Pivar Computing Services Inc., 165 Arlington Heights Rd., Buffalo Grove, IL 60089. Call 800-266-8378 or 708-459-6010 for more information. □

ASK THE ADVISOR

Send your question to PC Advisor, One Park Ave., New York, NY 10016, MCI mailbox PC MAGAZINE, or upload it to PC MagNet (see the instructions for joining on page 12 of this issue). We regret that we are unable to acknowledge submissions or answer letters individually.

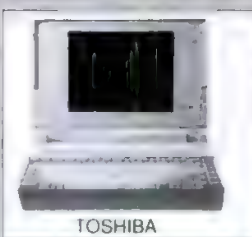
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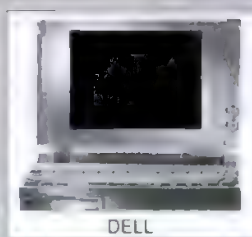
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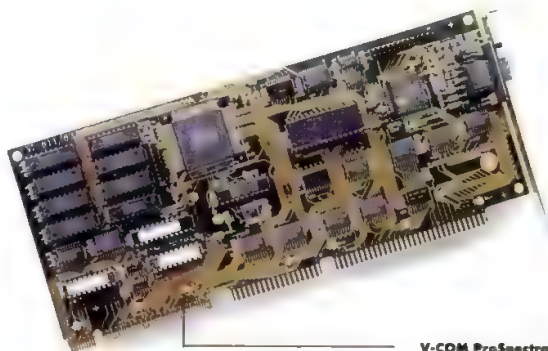
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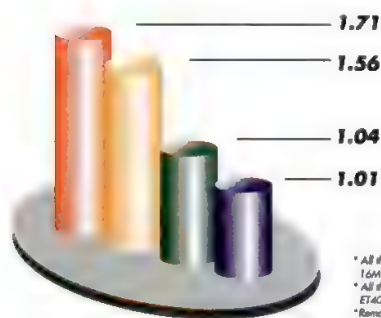
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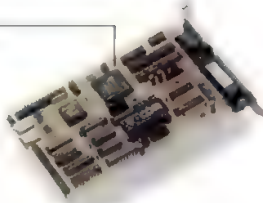
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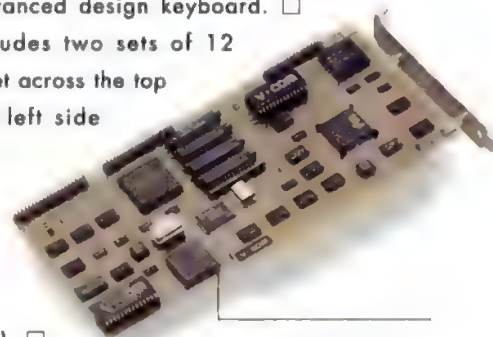
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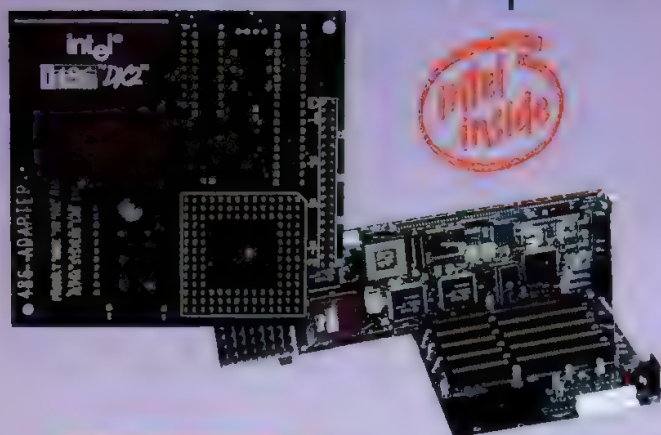
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TUTOR

Vanquishing Viruses: A sure cure for boot-record viruses Using EMS40.SYS in DOS 5.0: The /INT15 switch helps you get the extended memory you need

BY JEFF PROSISE

Vanquishing Viruses

Here's a tip for users experiencing the uncomfortable effects of a computer virus attack. If the infection comes from a virus attaching itself to the hard disk's master boot record (the bootstrap code stored in the first physical sector), you can eradicate it with a DOS 5.0 feature. The key is FDISK's undocumented /MBR (Master Boot Record) switch, which re-creates the master boot record and in doing so, effectively wipes out resident boot-record viruses. The command

```
FDISK /MBR
```

is all it takes. This is the quickest and safest means I've seen for ridding a hard disk of the Stoned virus. My guess is that it will prove equally effective in killing other boot-record viruses, too.

You need a virus-scanning utility to detect a virus, unless you know its signature and care to examine the boot record with DEBUG or a low-level disk editor. Common examples of boot-sector viruses are Anthrax, Joshi, Stoned, and Michelangelo. Note that some (such as Michelangelo) infect the master boot record and other parts of the disk. FDISK /MBR will only eradicate the viral code in the master boot record. Texts occasionally refer to MBR viruses as partition-table viruses, because the first physical sector of a hard disk also stores the master partition table (which defines how your hard disk is partitioned). But this is a misnomer. In addition, even though your master partition table is in the first sector along with the master boot record, if a virus wipes out that master partition table, FDISK /MBR won't fix it.

You can restore the master partition

table by repartitioning the disk, but that's doing it the hard way. If you run DOS 5.0, be sure to back up your hard disk's partition tables to a floppy disk. (Information about extended DOS partitions is stored outside the master partition table, so there can be more than one.) You'll need a little-used switch that accompanies the MIRROR command. If you type

```
MIRROR /PARTN
```

DOS creates PARTNSAV.FIL on a floppy disk. The file contains a copy of all your hard disk's partition tables. For convenience, keep the backup copy on a bootable DOS 5.0 diskette. If the partition data ever becomes corrupted (which would mean DOS would probably refuse to recognize one or more logical drives on the hard disk), pop in the floppy containing the backup file and type:

```
UNFORMAT /PARTN
```

UNFORMAT, started with the /PARTN switch, restores the partition tables from the information in PARTNSAV.FIL. If the partition tables were the only part of the disk corrupted, it should be as good as new again. DOS 5.0 also displays partitioning information when you type UNFORMAT /PARTN /L.

Finding the Date and Time

I'd like my AUTOEXEC.BAT file to run CHKDSK and MIRROR on Drive C: every Monday morning when I turn on my PC. To do this, I need a utility that returns the day of the week to a batch file. Can you help?

Samuel Schwartz
Brooklyn, New York

► **PC MAGAZINE** Follow the DEBUG listing in Figure 1 to create GETDAY.COM, which returns a value from 0 to 6 to identify the day of the week (0 equals Sunday, 1 equals Monday, and so on). The DEBUG script and the executable file can be downloaded from PC MagNet, archived as GETDAY.ZIP. You can then test the returned value in a batch file using the DOS IF ERRORLEVEL statement. Here's a batch file that does what you requested:

```
@ECHO OFF
GETDAY
IF NOT ERRORLEVEL 1 GOTO SKIP
IF ERRORLEVEL 2 GOTO SKIP
CHKDSK C:
PAUSE
MIRROR C:
:SKIP
REM The rest of your AUTOEXEC.BAT
REM file goes here
```

The statement IF NOT ERRORLEVEL 1 GOTO SKIP will branch to the line labeled :SKIP if GETDAY returns 0. IF ERRORLEVEL 2 GOTO SKIP will do the same if the return value is 2 or higher. On any day but Monday, the branch will

GETDAY.SCR

Complete Listing

```
A #100
MOV AH,2A ;Get date from DOS
INT 21 ;Day of week in AL
MOV AH,4C ;Load exit function code
INT 21 ;Terminate the program

N GETDAY.COM,
RCX
08
W
Q
```

Figure 1: GETDAY.COM returns a value from 0 to 6 to identify the day of the week.

GETHOUR.SCR

Complete Listing

```

A 0100
MOV AH,2C      ;Get time from DOS
INT 21
MOV AH,4C      ;Load exit function code
MOV AL,CH      ;Transfer hour to AL before exit
INT 21         ;Terminate the program

N GETHOUR.COM
RCX
0A
W

```

Figure 2: The DEBUG listing for GETHOUR.COM, a small program that returns the current time to DOS.

occur and lines between the ERROR LEVEL statements and :SKIP will be bypassed. On Monday, however, GETDAY will return 1, execution will fall through, and the lines will be executed.

GETDAY works by calling DOS function 2Ah, which returns (in the AL register) an integer from 0 to 6 representing the day of the week. Then the utility calls DOS function 4Ch to terminate, which causes the value in AL to become an exit code. The exit code, in turn, becomes the ERRORLEVEL value that a batch file can test with an IF ERRORLEVEL command.

It's equally easy to construct a short .COM file that returns the current time.

Let's say you want to write a batch file that waits until 2:00 A.M. to execute a hard disk backup or defragmenting program that can run unattended. Create GETHOUR—a utility that makes this task a snap—using the listing in Figure 2. You can download GETHOUR's DEBUG script and executable file from PC MagNet, archived as GETHR.ZIP.

GETHOUR returns an exit code from 0 to 23 that indicates the hour of the day in military time (where 12 noon is equal to 12, 1 P.M. is equal to 13, and so on). Using GETHOUR, the following batch file—started when you leave work—engages in an idle loop until 2:00 A.M., at which time it kicks out of the loop and executes the commands that follow the IF ERRORLEVEL statement:

```

:NOTTIME
GETHOUR
IF NOT ERRORLEVEL 2 GOTO NOTTIME
IF ERRORLEVEL 3 GOTO NOTTIME
REM Your commands go here

```

The only limitation in using GETHOUR is that it won't allow a delay of more than 23 hours. In this particular example, the batch file must be started no earlier than 3:00 a.m. on the day before you want the procedure to execute. Of course, the programs you choose to run must be able to run unattended. It won't do much good to start a disk backup program that requires floppy

shuffling if you don't plan on being around!

GETHOUR retrieves the current hour by calling DOS function 2Ch, which returns hours (0 through 23) in CH, minutes (0 through 59) in CL, seconds (0 through 59) in DH, and hundredths of a second (0 through 99) in DL. The routine then transfers the hour from CH to AL and executes DOS function 4Ch to terminate. The value identifying the current hour is returned as an exit code.

Using EMS40.SYS in DOS 5.0

In the past, I used *PC Magazine's* EMS40.SYS on my 286-based IBM Model 50Z to convert 256K of extended memory to expanded memory for Lotus 1-2-3, Release 2.0, and Quattro Pro, Version 3.0. Since I installed DOS 5.0, however, I now get the error message "Not enough memory" when I attempt to load the driver. Is there a fix for this? I'd like to be able to use EMS40.SYS and load DOS into the HMA with a DOS=HIGH statement in CONFIG.SYS.

*B. Knowles
Brooklyn, New York*

► **PC MAGAZINE** This is a fairly common problem among new DOS 5.0 users who use pre-DOS 5.0 drivers and applications that access extended memory the old way, without help from HIMEM.SYS. The problem stems from DOS 5.0's setup program, which adds a DEVICE= command to your CONFIG.SYS in order to invoke HIMEM.SYS. This is necessary if you're going to load DOS in the HMA (high memory area) with the DOS=HIGH statement.

By default, HIMEM.SYS takes over all the extended memory in your PC, making it available to other programs as XMS memory. Hence, when EMS40.SYS hunts for extended memory to convert to expanded, it thinks none exists. Unable to get the memory it needs, EMS40.SYS displays the error message you described and terminates. The solution is the HIMEM.SYS switch /INT15.

It's no wonder that most users don't know what the /INT15 switch does: The DOS manual says that it "allocates the specified amount of extended memory (in kilobytes) for the Interrupt 15h interface." Interrupt 15h is one of the vehicles that older programs such as EMS40.SYS used to allocate extended memory. Translated, this means you can use the /INT15 switch to reserve some extended memory for other programs—programs that are incapable of accessing extended memory by placing calls to HIMEM.SYS. In your case, if the DEVICE= command that loads HIMEM.SYS currently reads

```
DEVICE=C:\DOS\HIMEM.SYS
```

you should modify it to read:

```
DEVICE=C:\DOS\HIMEM.SYS /INT15=256
```

This will keep the 256K of extended memory in your PC from being converted to XMS memory by HIMEM.SYS. More importantly, EMS40.SYS will now find 256K of extended memory available to it, and will no longer report "Not enough memory."

This technique works for other programs besides EMS40.SYS. If, under DOS 5.0, you run any application requiring extended memory and it reports that none remains, use the /INT15 switch to set some RAM aside. □

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. Send your question to Tutor, *PC Magazine*, One Park Ave., New York, NY 10016, or upload them to PC MagNet.

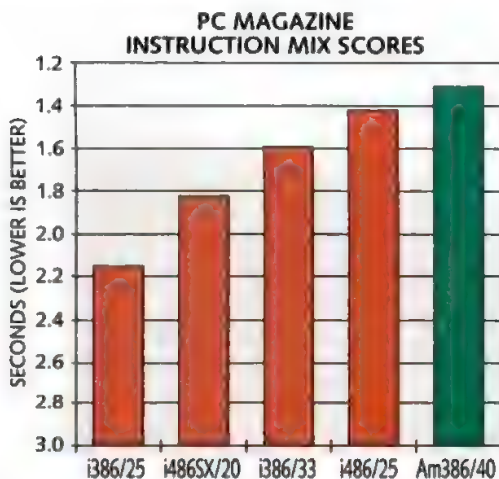
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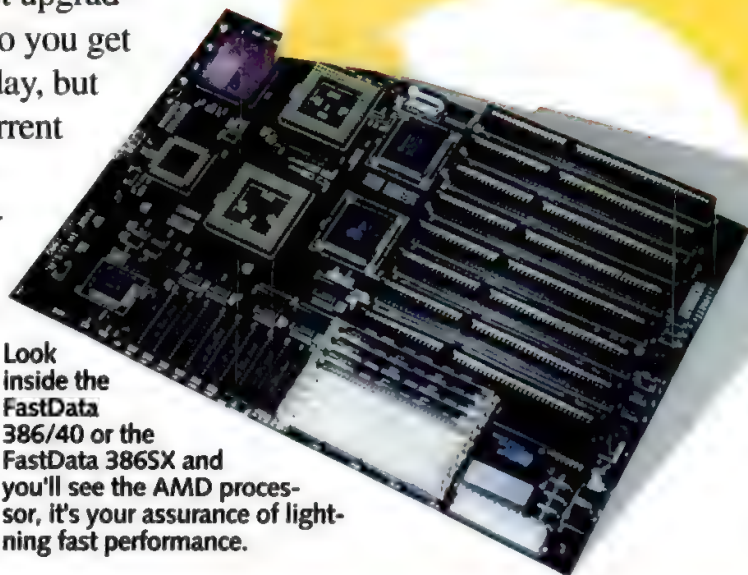
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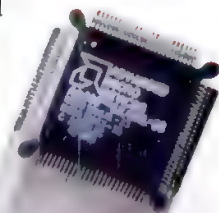
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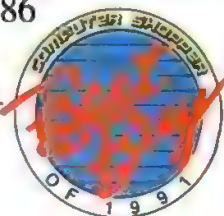
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- Microsoft Windows 3.1 & Mouse.
- MS-DOS 5.0.
- FastMicro Peace of Mind.



A System That's Cool & Quiet? FastMicro Innovates.



Every new desktop FastData PC comes with dual cooling fans. It has a main fan that's quieter than fans in ordinary PCs- plus, it includes a special second fan that comes on only when the system gets warm. A

cooler system lasts much longer - a concern particularly when upgrading to higher heat-producing clock doubler chips.

Fourth Generation Case

Our new desktop case has been developed to afford maximum strength, expandability and protection in a versatile and compact design. From the minute you look inside, you know this is not like the minimum cost cases most of our competitors use. It includes no less than seven drive bays and has extra protection against radio interference.

Powerful 170 Mb IDE Drive.

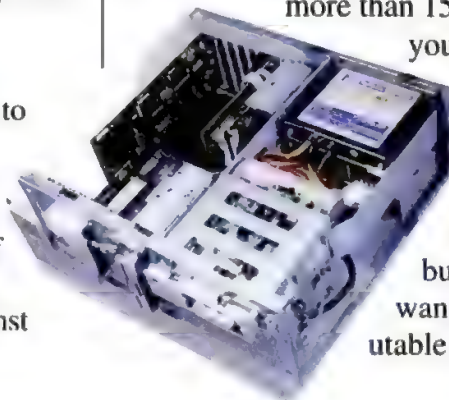
FastMicro includes Conner's CP-30174 170mb IDE hard drive standard in the FastData 386/40.

Conner has a reputation for building the most reliable drives on the market, in fact, the CP-30174 has a MTBF (mean time between failures) rating of

more than 150,000 operating hours. If

you ran your FastData system 24 hours a day - that's more than 17 years! Couple this with a <17 millisecond access time and 32K

built-in cache and you won't want to gamble on a less reputable drive.



Ultra-Fast, Ultra Clear Video

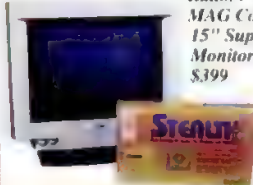
Order the FastData 386/40 and we'll include a High Performance Windows Video Accelerator Card at no extra charge. Its Tseng Labs ET-4000 graphics accelerator runs Windows *five times* faster than standard VGA cards and its Sierra Ramdac Hi-color chip delivers up to 32,768 colors. We top your system off with a Non-Interlaced Super VGA monitor with resolutions to 1024 x 768 and a sparkling 72hz refresh rate. Order either of our Am386SXL models and we include the non-interlaced monitor with a 1mb Super VGA Card (it's three times faster than standard cards).

Remember, when you buy from FastMicro, you can choose from hundreds of hardware and software products to enhance your system.



EDITOR'S CHOICE VIDEO BUNDLE

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- ⇒ Mini-Tower Chassis.
- ⇒ 72hz Non-Interlaced 14" Super VGA monitor, 1024x768 resolution.
- ⇒ 16 bit SVGA card with 1mb Ram.
- ⇒ Clock calendar, parallel port, game port and two serial ports.
- ⇒ MS-DOS 5.0, Microsoft Windows 3.1 & Mouse Included.

FastData386SX/33 \$1339

- ⇒ Adds a 16K Static Ram Cache



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SuperStor 2.0

\$77

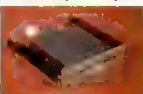
Install SuperStor and double or triple the capacity of your hard disk effortlessly. SuperStor's data compression operates in the background and is so fast, it actually improves the performance of many of your applications. Its universal data exchange feature even allows compressed floppies to be read by other non-compressed systems.



Teac 1.44mb 5.25" or 1.2mb 3.5 Floppy Drive

\$59

Genuine Teac quality at a low FastMicro price, these high density floppy drives also read, write & format low density floppy disks. They work great with all true 286, 386 & 486 compatibles. 1.44 mb 3.5" drive includes mounting kit and bracket. For rails for 1.2mb 5.25" drive, add \$5.



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IDE performance, big 130 megabyte capacity, 19ms access time and 5 mbps transfer rate make this a great buy. Controller, cables and rails are included to make installation fast and easy.

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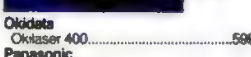
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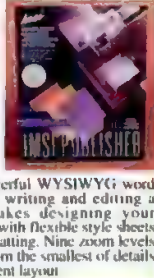
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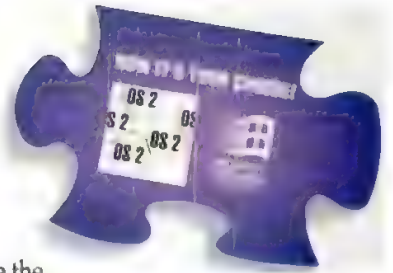
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USER-TO-USER

Storing the Date and Time: Putting the date and time into the environment A Special Prompt for Windows: Control the prompt used by every DOS window

BY NEIL J. RUBENKING

toggling Printer Echo

Pressing either the Ctrl-PrintScreen or Ctrl-P key combinations will turn echoing of all standard output to the printer on or off. For years I've tried to figure out how to automate this in a batch file, and I finally succeeded.

I created a file called CTRL.P.CHR (using *PC Magazine's* TED utility) that contains a Ctrl-P followed by a carriage return and line feed. In my batch file I redirect this file into the TIME (or DATE) command as follows:

```
TIME < CTRL.P.CHR
```

This works just as if I had typed Ctrl-P, then leaves the time alone by following with an Enter keystroke. As a helpful side effect, the time shows up on the printed output. Other commands might allow a similar function.

I make use of this technique several times a month when updating machines on a network. Rather than copying all files from the server, I use a utility to copy only the new ones. But before copying, I turn on the printer echo so that I get a printed log of what was copied, in case any problems arise later.

*Timothy R. Muggli
Des Moines, Iowa*

► **PC MAGAZINE** Printer echo is a special mode for DOS—when it's turned on, everything that's written to the screen via DOS standard output gets echoed to the printer as well. Pressing Ctrl-P or Ctrl-PrintScreen turns printer echo on if it's currently off, or off if it's currently on. When printer echo is on, you get an automatic printed record of everything that happens at the DOS prompt. Very few

applications use DOS standard output, so printer echo is useful chiefly for capturing the output of DOS commands.

I use a tiny .COM file to toggle printer echo within a batch file; however, it is possible to do the same thing using simple DOS commands. If you don't need to record the time when you toggle printer echo, you can redirect the CTRL.P.CHR file into PAUSE instead:

```
PAUSE < CTRL.P.CHR > NUL
```

If you happen to omit the > NUL from this line, the familiar "Press any key to

*Printer echo is a special
mode for DOS—when it's
on, everything that's
written to the screen via
DOS standard output gets
echoed to the printer.*

continue..." message will be printed out.

I tested this method successfully in DOS versions 2.1, 3.1, and 5.0, so it should be safe to assume that it will work in all versions. In a DOS window under DESQview, however, it worked only sporadically.

PC Magazine's TED (Tiny EDiTOr) utility is handy for entering control characters into files, but if you don't have it you can use DEBUG to create the CTRL.P.CHR file. Just type the following commands at the DEBUG dash prompt, or store them in a file and redirect the file into DEBUG:

```
NCTRL.P.CHR
E 100 10 0D 0A 1A
RCX
I
W
Q
```

But there's another way to toggle printer echo in a batch file that's easier still. Using an editor like TED that allows the insertion of control characters, just include a line like this:

```
ECHO ^P | PAUSE > NUL
```

Here, *P* represents the character produced by holding down the Ctrl key and pressing P, *not* the two characters caret and P. It may look like a right-pointing triangle in your editor.

There's still one unsolved problem regarding printer echo, and that's how to turn it specifically on or off. Pressing Ctrl-P or using any of the methods mentioned above simply toggles the mode. I don't know of a way to actually detect the current mode or to set a particular mode. If you solve this problem, be sure to send in your solution!

Fast Maximize/Restore

Here is a trick that I stumbled on. It may be widely known in some circles, but it's new to everybody that I've talked to.

Instead of using the arrow at the top-right of an application window to maximize or restore a window, you can simply double-click on the title bar. This toggles between the maximized and restored states of the window. It's a lot easier, because the title bar is larger.

*William Luitje
Ann Arbor, Michigan*

► **PC MAGAZINE** This is a great and little-known trick. It is especially good for 800-by-600- and 1024-by-768-pixel Super VGA displays, where the Maximize/Restore button is much harder to hit because it's relatively smaller than it is in VGA mode.

Storing the Date and Time

CURR_UPD.BAT (Figure 1) is a batch file that sets the current date and time as an environment variable, and does it in a very useful format. The batch file first creates a 0-byte file called SET-CURR.BAT. It then stores the result of the DIR listing of SET-CURR.BAT in SET-CURR.BAT. Next, it calls EDLIN to edit SET-CURR.BAT, taking the input for EDLIN from the script file UPDATE.SCR, shown below. (The • symbol represents a space.)

```
1sSET
.,1m
1,1r • BAT • • • • • ^Z=
1,1r • 0^Z •
1,1r^Z •
1,1r:^Z • :
1,1ra^Z • AM
1,1rp^Z • PM
2,8d
e
```

UPDATE.SCR's first two lines find the line in SET-CURR.BAT that begins with SET and replaces the first line of SET-CURR.BAT with it. For DOS, Versions 3.3 and earlier, that line looks like this:

CURR_UPD.BAT Complete Listing

```
@ECHO OFF
REM:
REM  *** Batch File Program to set Environment Variable ***
REM  *** CURR = to the current MO DAY YR  HR MIN AM/PM ***
REM:
REM  *** Create a 0 byte file ***
REM > SET-CURR.BAT
REM  *** Get current date and time into SET-CURR.BAT ***
DIR SET-CURR.BAT > SET-CURR.BAT
REM  *** Edit SET-CURR.BAT to set Environment Variable ***
REM  *** CURR equal to the current date and time ***
EDLIN SET-CURR.BAT < UPDATE.SCR > NUL
REM  *** Set CURR ***
call set-curr
REM  *** Cleanup ***
DEL SET-CURR.*
```

Figure 1: With a little help from the EDLIN script shown in column 1, this batch file creates an environment variable that contains the current date and time.

SHOWCURR.BAT

Complete Listing

```
@ECHO OFF
REM SHOWCURR.BAT
IF '%1'==' ' SHOWCURR %CURR%
ECHO This is the %2th day of the %1th month of 19%3
IF '%6'=='AM' ECHO The time is %4%5 in the morning.
IF '%6'=='PM' ECHO The time is %4%5 in the afternoon/evening.
```

Figure 2: Run this batch file with no parameters—it calls itself, passing the value of the CURR environment variable.

```
SET-CURR BAT 0 9-15-91 8:03a
```

For DOS 4.0 and later, it's a bit different:

```
SET-CURR BAT 0 09-15-91 8:03a
```

The third line in the EDLIN script then replaces "BAT" (there are seven spaces after BAT) with "=". The remaining lines delete the 0 file size and the leading 0 in the month (for DOS 4.0 and later), remove dashes and insert spaces that serve as field delimiters, replace the a or p with AM or PM, and delete all lines after the first. SET-CURR.BAT now reads:

```
SET CURR= 9 15 91 8 :03 AM
```

CURR_UPD.BAT now calls SET-CURR.BAT and the environment variable CURR is set with the date and time. (You may substitute any valid filename characters for CURR, but you must use four characters.)

I run CURR_UPD.BAT from my AUTOEXEC.BAT file. One way I use the CURR environment variable is to

open or create a monthly note file with my text editor. A first batch file, MONTHLY.BAT, calls a second one, GETFILE.BAT, passing it the value of the CURR variable:

```
@ECHO OFF
REM MONTHLY.BAT
GETFILE %curr%
```

GETFILE.BAT calls the editor with a filename built from the elements of the CURR variable:

```
@ECHO OFF
REM GETFILE.BAT
IF %1==1 EDITOR \DOC\JAN.%3
:
:
IF %1==12 EDITOR \DOC\DEC.%3
```

If, for instance, the current month is April 1992, %1 would be 4, %3 would be 92, and GETFILE would call the note file APR.'92.

*Dave Graczyk
East Amherst, New York*

► **PC MAGAZINE** The CURR environment variable does indeed have a handy format to use in batch files. Each of the date and time elements is separated from the rest by a space, so if you pass the value of CURR to a batch file, each is treated as a separate parameter. You can't pass %CURR% to a batch file from the command line, but the batch file shown in Figure 2 demonstrates a way to get around this limitation. Call SHOWCURR with no parameters and it simply runs itself again, this time passing the value of the CURR variable.

Note that the REM line in CURR_UPD.BAT that initially creates the SET-CURR.BAT file isn't strictly necessary. The line following



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```
DIR SET-CURR.BAT > SET-CURR.BAT
```

will work just fine even if SET-CURR.BAT doesn't yet exist. DOS always evaluates any redirection in a command line before executing the rest of the line, so the first thing it does is open SET-CURR.BAT to hold redirected output. After that, it executes the DIR command, which finds the newly created SET-CURR.BAT file. At this time, the file has a size of 0 because DOS just opened it, so the directory line DOS writes to the file indicates a size of 0. Of course, after this line is complete, the .BAT file is no longer a 0-byte file!

(All files mentioned in this item can be downloaded from PC MagNet archived as CURDAT.ZIP.)

A Special Prompt for Windows

There's an easy way to get a helpful prompt when you're in a DOS window inside of Windows 3.1. Just put the line

```
SET WINPMT=Type Exit to return to  
Windows $p$g
```

into your AUTOEXEC.BAT file. Windows replaces the value of the PROMPT variable with WINPMT's value, so at the command line in a DOS window you would see the message "Type Exit to return to Windows C:\>".

Andy Cemelli
Fair Lawn, New Jersey

► **PC MAGAZINE** The command line prompt of a full-screen DOS window running under Windows doesn't look any different from the standard DOS command line. If you forget that you're shelled out of Windows, you may blunder and run another copy of Windows, or run a DOS program like CHKDSK that isn't safe under Windows. Setting the WINPMT environment variable provides an automatic reminder that you're running Windows any time you're at the DOS prompt. Run a DOS program like WordPerfect and shell out from that program to DOS—your WINPMT reminder will still be there!

A WINPMT string is exactly like a PROMPT string and uses the same special characters. The example above prefixes a reminder string to the common

\$p\$g prompt string (\$p stands for the current drive and directory, \$g for the greater-than symbol). You can improve the example by adding the special character \$_ before \$p\$g:

```
SET WINPMT=Type EXIT to return to  
Windows$_$p$g
```

This puts the drive and directory line on the line *below* the reminder.

If your CONFIG.SYS file loads the ANSI.SYS driver, you can even add

*Setting the WINPMT
environment variable
provides an automatic
reminder that you're
running Windows any
time you're at the DOS
prompt.*

color. The elaborate WINPMT string below creates an unmistakable red, white, and blue prompt:

```
SET WINPMT=$e[0;44;37m Win  
dows $e[40;31;1;5m EXIT $e[0;  
1;37mto returns$_$e[34m$p$g
```

Try it. Put this command into your AUTOEXEC.BAT and see what happens when you open a DOS window. If you don't like the results, experiment with it a little bit! Find a reminder prompt that suits you and then install it in your AUTOEXEC. You'll never forget when you have shelled out of Windows.

Corrections

Thanks to all of you who wrote (by mail or electronically) about the /F switch for COMMAND.COM, mentioned in the March 17, 1992, column. I stated then that the /F switch is new in DOS 5.0; apparently everyone but me has been using it since DOS 3.1. I did check for its presence in earlier versions of COMMAND.COM by seeking it with DE-

BUG. Clearly, though, I was looking in the wrong place!

For those who missed the original article, you add the /F switch to the SHELL= line in CONFIG.SYS or to the command line of a secondary command processor (COMMAND /F for example). When this switch is active, DOS automatically answers F for Fail to any "Abort, Retry, Fail?" prompt.

A number of you noted that JP Software's 4DOS command processor also provides the /F switch's functionality, but the 4DOS manual recommends *against* using it. The argument against using the /F switch in 4DOS applies equally to COMMAND.COM: a truly critical error, not merely an empty disk drive, might slip by without your knowledge. No matter which command processor you rely on, you have to decide for yourself whether to use /F.

Several of you also noted a missing number in the February 11, 1992, column. The program presented there, ALTPAUSE2.COM, is used to pause batch file execution for as long as any of the Shift, Ctrl, or Alt keys is held down. It also sets the DOS ERRORLEVEL to 255 if the pause was invoked (though the text says it sets ERRORLEVEL to 1). Here's how the batch line that branches based on this test *should* read:

```
IF NOT ERRORLEVEL 255 GOTO NoPause
```

The updated version of ALTPAUSE2 can be downloaded from PC MagNet, archived as ALTPAUSE2.ZIP. Thanks again for keeping me honest! □

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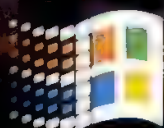
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SPREADSHEETS

A Linked-File Bug in 1-2-3: Your linked formulas may not always reference the correct cell

Worksheet Security: How to prevent other users from overwriting your work

BY CRAIG STINSON

A Linked-File Bug in 1-2-3

If you use formulas to link worksheets in Lotus 1-2-3, Release 3.1, you should be aware of an insidious file-save bug. This bug occasionally causes linking formulas to lose track of the cells that they reference. If you change the location of a cell referenced by a linking formula—either by moving that cell or by inserting or deleting rows or columns on the source worksheet—the linking formula gives the appearance that it is tracking the new location of the source cell. But appearances are sometimes deceiving.

If you rearrange the source worksheet, then use the /File Save [All Modified Files] command to save both the source worksheet and the target worksheet (the sheet containing the linking formula), sometimes the linking formula is saved correctly and sometimes it is not. When the target file window is visible on the screen, whether in full-screen view or in perspective mode, 1-2-3 will recognize that the target sheet has been modified and will save it when you choose the [All Modified Files] option. However, if the target sheet is not visible, 1-2-3 does not recognize that it has been modified and doesn't save the change. As a result, the next time you open the target worksheet, the linking formula references the wrong cell.

For example, a formula that reads as follows

```
+<<SOURCE.WK3>>A1..A1
```

changes to reference B1 if the contents of <<SOURCE.WK3>>A1 are moved to B1. But if you use the all-file save command, quit, restart, and reopen the worksheet with the link formula, that formula

again—and now incorrectly—references cell A1!

A spokesperson at Lotus acknowledged the bug and said that it would be fixed in Release 3.4 and in 1-2-3 for Windows. In the meantime, however, there's a simple remedy: Never reference an external cell by its address. Always name the source cell (or range) and then use that name, not the address, in your linking formula. When you move a named

If you move to Windows and begin using DDE to connect worksheets with other applications, you must get into the habit of creating links by name.

cell or range (or when the named entity gets relocated as the result of worksheet additions or deletions), 1-2-3 always updates the name table immediately. References to the named cell or range remain valid, whether they're in the same worksheet or a different one. Fortunately, the file-save bug does not trash worksheets that link by name.

If you move to Windows and begin using DDE to connect 1-2-3 worksheets with other applications (for example, Ami Pro documents), you must get in the habit of creating links by name rather than by cell address. Even if no file-save bugs are at work, an application on the receiving end of a DDE (or OLE) link can't be expected to track the migrations of cells on a 1-2-3 worksheet.

Worksheet Security

As an instructor of Lotus 1-2-3, I have found many students in need of better security than that provided by 1-2-3's password-protection system. For example, my students often create worksheet templates, intending that users call these templates up, work with them, and then save them under a new name. Unfortunately, the templates often get overwritten by accident and have to be re-created from scratch.

I designed the macro shown in Figure 1 to deal with this problem. The macro uses DOS's ATTRIB command to assign the read-only attribute to the current file. Pressing Alt-S produces a simple custom menu with commands to add and remove security. Once the user has chosen the Add Security command, the current file can no longer be saved under its current name.

Rob McCormack
Thunder Bay, Ontario
Canada

►**PC MAGAZINE** This macro works in 1-2-3, Releases 2.2, 2.3, and 2.4. In all three versions, the macro statement {system COMMAND} lets you skip out to the DOS prompt and execute a command or other DOS program. In order to add the read-only attribute to a file, Mr. McCormack concatenates several string elements to produce a command that looks like this:

```
{system "ATTRIB +R D:\FILESPEC"}
```

A similar command, with a minus sign replacing the plus, removes the read-only attribute. In both cases, d:\filespec is the complete path and name of the current

SECURI.WK1

Complete Listing

	A	B	C	D
1	\S	{menubran		
2		CH		
3	CHOICES	ADD Security	REMOVE Security	Quit
4		+CHOICES&" to file "&FILENAME	+C3&" from file "&FILENAME	Quit Security Macro
5		+ "{system ""ES&\$ADDATTRIB"ES&"}"	+ "{system ""ES&\$REMOVEATTRIB"ES&"}"	{quit}
6		{quit}	{quit}	
7				
8	FILENAME	@CELLPOINTER("filename")		
9				
10	ADDATTRIB	+ "ATTRIB +R "&FILENAME		
11				
12	REMOVEATTRIB	+ "ATTRIB -R "&FILENAME		
13				
14	QUOTES	"		



Figure 1: This 1-2-3 macro adds or removes the read-only attribute to or from your worksheet. This gives you the ability to protect the sheet from unwanted modifications by other users, since they won't be able to save the file under the name it currently has.

SECURI.WQ1

Complete Listing

	A	B	C	D
1	\s	{calc}{MenuBranch CHOICES}		
2				
3	CHOICES	ADD Security	REMOVE Security	Quit
4		+CHOICES&" to file "&FILENAME	+C3&" from file "&FILENAME	Quit Security Macro
5		{/ Basics;Shell}	{/ Basics;Shell}	{Quit}
6		+ "ATTRIB +R "&FILENAME&" ~ "	+ "ATTRIB -R "&FILENAME&" ~ "	
7		{Quit}	{Quit}	
8				
9	FILENAME	@CURVALUE("file","save")		



Figure 2: A Quattro Pro version of the macro in Figure 1. This version adds the {calc} command, which should also be added to the 1-2-3 macro.

file (the file in which the macro is being executed) and that file specification is obtained by means of the @CELLPOINTER("filename") formula.

Note that the quotes around the ATTRIB command are required because the argument for {system} must be a text string. Mr. McCormack concatenates the quotes into the string by referencing a cell containing nothing but a quotation mark.

In Figure 1, the Text format (/Range Format Text) has been applied to cells B4..C5, B8, B10, and B12. What you see in the figure is what you should type in, not what the formulas will return on your worksheets (unless you also format them as Text).

The macro in Figure 1 needs one important fix: A {calc} statement must be included at the beginning of the macro run to ensure that the result of the @CELLPOINTER formula is current. Without the {calc} statement, if you save the current file under a new name and then run the macro, you'll be changing the attribute of the file under its former name. The simplest way to fix this is to make the macro's first line read:

```
{calc}{menubran
```

Figure 2 shows a Quattro Pro version of Mr. McCormack's security macro. The shell-to-DOS command in Quattro Pro looks like this:

```
{/Basics;Shell}
```

followed by the DOS command to be executed. The function that returns the name of the current file is

```
@CURVALUE("file","save")
```

Note that the "filename" argument for @CELLPOINTER is not available in Quattro Pro.

The {calc} statement is particularly important for Quattro Pro users who work with two or more files at once. @CURVALUE ("file","save") returns the name of the file that was active (the foreground file) at the time of the most recent recalculation. If you switch back and forth between several open files, the @CURVALUE formula may not be current if you don't do a recalc at the start of the macro.

Mr. McCormack's approach to template protection does not work in Lotus 1-2-3, Release 3.x; 1-2-3 for Windows; or

Excel. That is because those programs leave the worksheet file open (at the DOS level) while you work in them. Attempting to change the attribute of an open file will earn you an error message from DOS.

In Excel, you can protect a file as a template simply by using the Options button in the File Save As dialog box and choosing the Template format. When you reopen a file in this format, Excel will force you to rename the file before it will allow you to save it as a normal worksheet file. □

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BY M. DAVID STONE

Enhance WordArt Objects

Word for Windows 2.0 incorporates WordArt, a mini-application that lets you produce special effects with text. But you can actually go far beyond WordArt's built-in effects by combining WordArt with Draw, another mini-application that comes bundled with WinWord. With WordArt alone, all the text in a WordArt object shares the same size, typeface, positioning, color, and so on. But if you take advantage of Draw, you can manipulate each individual letter to achieve some interesting visuals. Figure 1 gives some indication of the possibilities.

To create special effects like those in Figure 1, start by creating a WordArt object in your WinWord document. Choose Insert Object, select MS WordArt, and choose OK. Once in Word Art, enter the text and special effect to use, and choose OK to insert your creation into your document. (You should see the WordArt ob-

ject in your document at this point. If you see an EMBED field code instead, choose View, Field Codes.)

Once you've created the WordArt object, you can at any time unlink it from WordArt and link it to Draw. To unlink the object, first select it. (To select it, simply click on it with the mouse, or place the cursor one character before the object, hold down the Shift key, and hit the Right Arrow key.) Next, press Ctrl-Shift-F9 to replace the field with the current field result, then double-click on the object or choose Edit, Picture. WinWord will create an EMBED field with a link to Draw, and then open Draw, complete with the text you originally created in WordArt.

Unlike WordArt, Draw will treat each letter of the text as a separate object. Each character will have its own set of four handles so you can manipulate it independently of the others—to resize it, change its color or pattern, or drag it to

a new location. Any changes you make and accept will show up in the object when you return to your document.

There is one other effect worth special mention. When you double-click on an individual letter in Draw, the character will show in outline form with control handles at various positions along the outline. You can then change the shape of the character by dragging any handle. Figure 2 shows one example of what you can accomplish with this capability.

Joel Heller

Chappaqua, New York

► **PC MAGAZINE** Not only does this technique open up new possibilities for special text effects, but it lets you combine fancy text with Draw's drawing features. Figure 3 started out as text created in WordArt and modified in Draw. I then used the appropriate drawing tools to add the ellipse and rounded rectangle, drew the star with the Freeform tool, and used

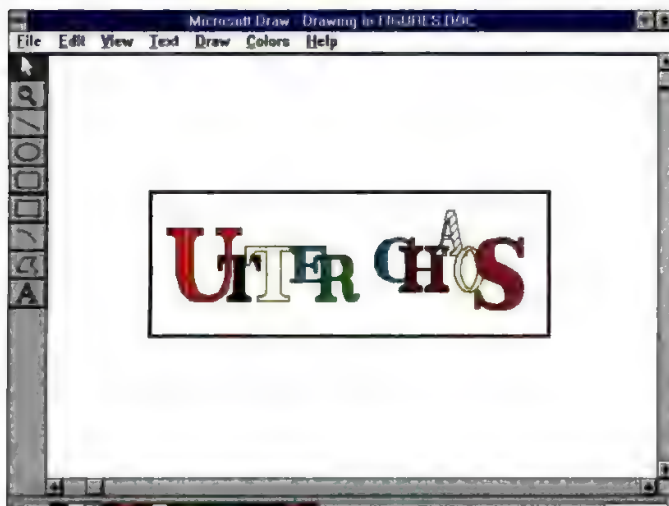


Figure 1: This visual effect was created in Word for Windows 2.0, using WordArt to create the original text and Draw to modify the shading, patterns, and size of the individual letters.



Figure 2: You can also use Draw to distort the shape of characters originally created in WordArt. The top word shows the characters before modifying them with Draw; the bottom word shows the result.

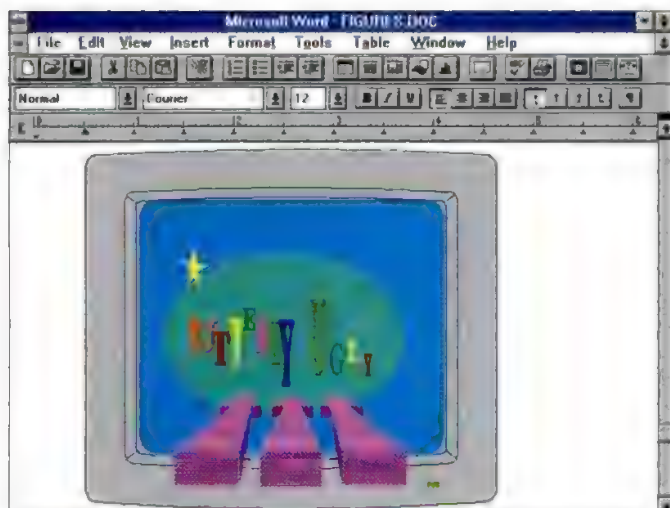


Figure 3: You can use any of Draw's features to add graphics to an object. The oval and rounded rectangle were produced by Draw tools, and the star was drawn using the Freeform tool. The arrows and monitor were added from WinWord's collection of clip art.

the File, Import Picture command to add the monitor and arrows (two clip-art images that come with WinWord 2.0).

Don't bother trying these tricks with Equation Editor objects. If you do, you'll find that Draw treats the characters created by Equation Editor as text, with the same limitations as text created within Draw.

The visual effect that Mr. Heller mentions at the end of his letter deserves more discussion, particularly if you've never used this feature in Draw before. Figure 4 (a) shows the letter T after you double-click on it. You can think of the outline of the character as a rubber band, and the control handles—the small squares along the outline—as fixed pins that define the shape the rubber band takes. If you move one of the handles, as shown in Figure 4 (b), the outline stretches, giving the character

a new shape.

You can even add or delete control handles. To add a control handle, hold down the Ctrl key. The mouse cursor will change to a small circle with a plus sign at the center. Move the cursor to the place where you want a handle and then click. You can now use that handle just like any other.

Figure 4 (c) shows the character T after you add two handles to the vertical stroke of the T and move them to change the shape.

To delete a control handle, hold down both the Ctrl and Shift keys. The mouse cursor will change to a small square around a minus sign. Move the square over the handle you want to delete, and click. Figure 4 (d) shows the character T after you remove four of the handles

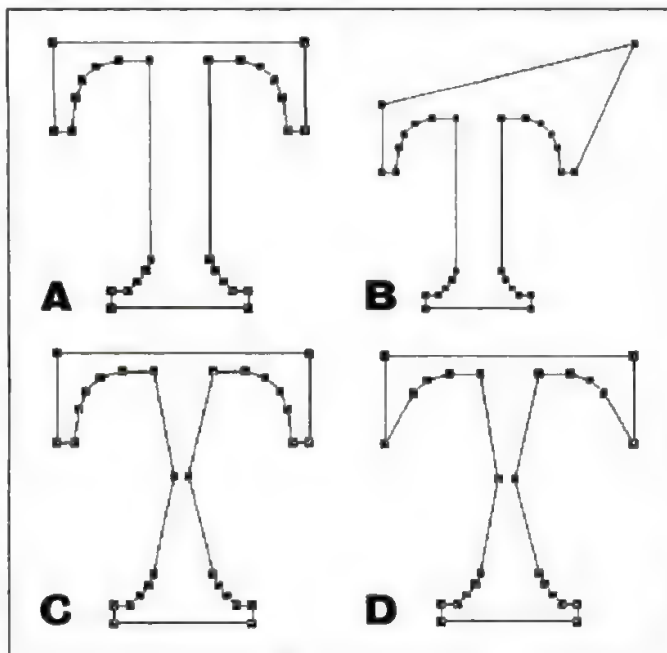


Figure 4: In Draw, if you double-click on a character brought in from WordArt, you'll see the outline of the character with handles placed along the outline (a). You can then click on and drag a handle (b). Figure 4 (c) shows the character after adding two more handles and moving them to change the character's shape. Figure 4 (d) shows the original character after removing several handles from the top of the T.

from the horizontal line of the T.

Finally, keep in mind that when it comes to visual effects, less is very often more. It's easy to get carried away and wind up with something, like Figure 3, that is utterly ugly. Ransom-note typography is best left for ransom notes.

More on WordPerfect Templates

In the February 11, 1992, Working Word column, you advocate inserting a space in the WordPerfect editing screen before retrieving a template file in order to avoid loading the master file. However, if the master template contains a Left/Right Margin code at the beginning of the file, WordPerfect will insert a hard return before the Left/Right Margin code when you retrieve the file.

My solution is to have the macro insert a hard page break into the blank screen before retrieving the template file, and then have it backspace out the hard page break afterward. This leaves the template copy uncorrupted by hard returns.

*Alan C. Baird
Glendale, Georgia*

► **PC MAGAZINE** The discussion of templates and how to avoid corrupting them generated a lot of mail, though this was the only letter that pointed out this specific problem. WordPerfect does indeed add a hard return if the template file includes a Left/Right Margin code at the beginning of the file. And for those who have margin codes in their templates, using a hard page break (or hard return) rather than a space lets you use a single general-purpose retrieval macro for all templates, without needing an extra step for some templates to delete the added carriage return manually.

Several letters pointed out that you can also protect templates from accidental overwriting with the DOS ATTRIB command. The DOS command

```
ATTRIB FILENAME +R
```

will set a file to read-only, while the command

```
ATTRIB FILENAME -R
```

will return it to its usual state, which will let you delete or overwrite it.

The Working Word

In general, though, the ATTRIB command is better avoided for protecting templates. Using it can be incredibly awkward—especially in the early stages of developing a template. When you think the template is finished, you'll often set the file to read-only and then find out that it needs another change. The technique I described in the February 11 column has the advantage of protecting the template without this awkwardness. Even so, if you develop templates for others, you might like to use ATTRIB to protect finished templates from accidental modification. But be aware that if you copy a file that's set to read-only, the new copy does not carry over the read-only setting.

Importing Spreadsheets

If you import entire worksheets as tables into WordPerfect 5.1, it's useful to know that there's a faster way than the Text In/Out command. In fact, WordPerfect 5.1 can load spreadsheets as tables through its standard file retrieve features—List Files (F5) and Retrieve (Shift-F10)—or

by adding the filename to the DOS command line when starting the program (using: WP filename). Retrieve the file using the same procedure you would for any WordPerfect text file. WordPerfect will recognize the file format and import the entire spreadsheet as a table.

Craig Edward Given
Chattanooga, Tennessee

► **PC MAGAZINE** If this feature is covered in the WordPerfect manuals or Help screens, it's certainly well hidden. The only reference I could find to importing spreadsheets was with the Text In/Out command. The procedure there, which is not available in versions earlier than 5.1, is to press Ctrl-F5, Spreadsheet, Import, then enter the filename, and give the Perform Import command.

Nevertheless, the simpler approach works—at least with the Lotus .WK1, Lotus .WK3, and Quattro Pro .WQ1 formats that I tested. (Note that WordPerfect 5.1 only supports Microsoft Excel versions 2.x.) And loading a spreadsheet from the List Files screen or with the Shift-F10

(Retrieve) command takes fewer keystrokes than using the Ctrl-F5, Spreadsheet, Import command.

Keep in mind, however, that this only works for loading entire spreadsheet files, and only if you want to load them as tables. If you need to import a range from a spreadsheet, import the spreadsheet as text, or create a link to a spreadsheet, you'll still have to use the Ctrl-F5, Spreadsheet commands. □

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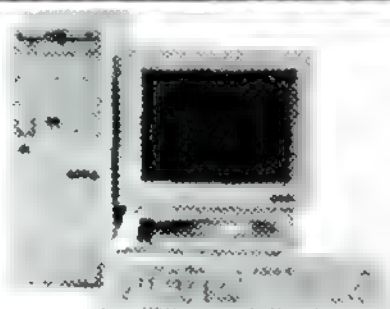
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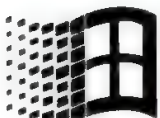
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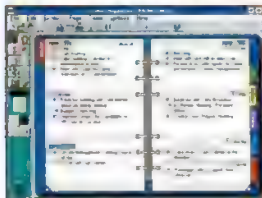


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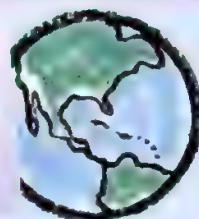
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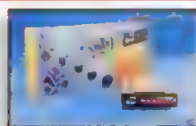
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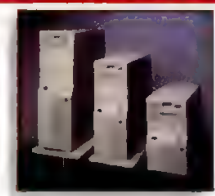
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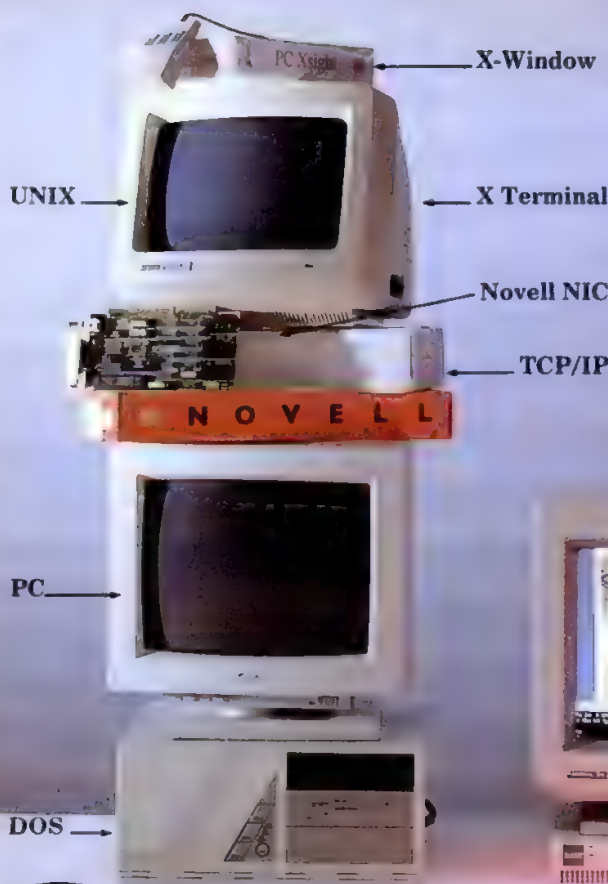


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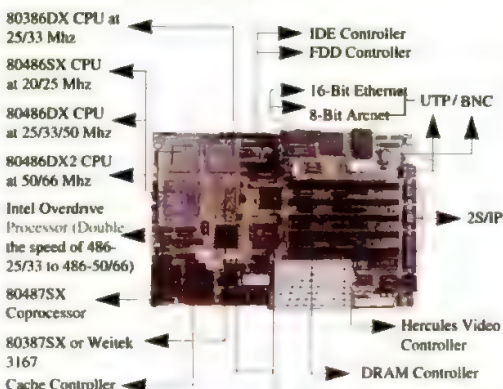
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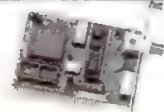
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CIRCLE 219 ON READER SERVICE CARD

CONNECTIVITY

Novell's Burst Mode Protocol: Make more efficient use of expensive long-distance circuits **Client/Server Computing:** A better way to generate database reports

BY FRANK J. DERFLER, JR.

Novell's Burst Mode Protocol

If you have a NetWare 3.x network with any type of wide area connection, you should be aware of Novell's new Burst Mode protocol. This software, which consists of a BNETX.COM program running on client PCs and a PBURST.NLM file on the server, lets your network exceed NetWare's 512-byte packet limit so that it can make more efficient use of expensive long-distance communications circuits.

It's been widely—and incorrectly—stated that Novell's IPX protocol requires an acknowledgment for every packet. Actually, it's the higher level NetWare Core Protocol (NCP) that imposes the SEND-ACK sequence on IPX. This sequence is a reasonable precaution on LAN cables with signaling speeds of many megabits per second, but it becomes a drag on long-distance lines that operate at rates ranging only from 56 Kbps (kilobits per second) to just over 1 Mbps (megabit per second).

According to Novell, IPX has always been capable of sending packets without acknowledgment (a datagram protocol). The new Burst Mode software allows a client PC to create IPX packets of up to 64K and to send those packets back-to-back. This type of transmission makes the most efficient use of an expensive long-distance low-speed circuit.

The amount of throughput you gain using Burst Mode depends on many variables, including how much data the client PCs write versus how much they read (writing is a one-way task while reading demands a response), the size of the files, and how the applications handle the data. If an application only handles data in small blocks, nothing the underlying net-

work software does will help. The larger the files you move, though, the bigger cumulative improvement you'll see: around 100 percent for typical applications to perhaps 400 percent in ideal situations.

Clearly, doubling your throughput can forestall the need to invest several thousand dollars a month in a higher-speed leased line, so this is a worthwhile step. Novell reports an overall throughput gain of as much as 50 percent using Burst Mode on regular Ethernet and Token-Ring systems because of the reduced overhead, but note that gains on any individual system will vary widely.

You pay for using Burst Mode, though, in client PC RAM. The size of the IPX packet you define drives the amount of conventional memory used for buffers in the client PC. If you allow 64K packets, you might lose slightly more than 128K of conventional memory to the Burst Mode software. You can vary the configuration, though, for best results. And you don't have to use the Burst Mode software in all of the client PCs, just those that will benefit from it. Burst and non-burst clients can communicate with burst-equipped servers.

Burst Mode is a valuable and useful feature that can save money and improve performance. The Burst Mode feature is available as a software update from NetWare dealers, and it's also part of a \$30 product, the NetWare Workstation Kit for DOS and Windows, which you can get by calling 800-873-2831.

Client/Server Computing

I'm working on a program written in Clipper that is destined for a NetWare LAN. I've read about a product called ExtendBase from Extended Systems that

is supposed to bring client/server technology to Clipper applications, but I'm not sure what that means. The product description suggests that ExtendBase will move all the processing from the workstation to the file server and deliver only the results back to the client PCs. But our client PCs have no hard disks and the application is started from the network drive, so how does our type of system fit into this scheme? What do we gain?

*Andreas Zinschitz
via CompuServe*

► **PC MAGAZINE** In a database system, client/server architecture proves its worth when you generate reports. In typical distributed architecture, an application program generating a report on a client PC will ask the server for the files or parts of files containing the tables (assuming a relational model) it wants to examine. If the tables are large, this can amount to perhaps hundreds or thousands of megabytes of data streaming across the network. The processing takes place in the workstation, but the load is on the network itself, not the client's storage.

In the client/server model, on the other hand, a piece of software called a database engine runs in the server. This software cruises through the data on behalf of the application, compiles the report, and sends only the report across the network to the client application. The benefit you get from a client/server architecture is proportional to the size of your database and how often you generate reports. The downside is that the database engine takes memory and processing power from the server, so it might adversely impact network efficiency in its own way. But if you have a large, frequently used database and a fast file

server with a minimum of 16MB of memory, using the client/server architecture could save you processing time and relieve network overload.

LANs in Different Buildings

We need to link two LANs that are located in different buildings about 2,000 feet apart, but we can't get the right-of-way for cabling between the buildings. The ground between the buildings is covered with cement, there are no overhead lines, and, while we have a line-of-sight path, it is obscured by trees for much of the year. Can you suggest a solution?

Bill Bates
Phoenix, Arizona

► **PC MAGAZINE** I can think of two possibilities: a leased line or a radio link. First, call your local telephone company and ask about a leased line between the two locations. They might have a local cable you could lease that would give you service at 56 or 64 Kbps (kilobits per second). You would have to invest in suitable interface equipment, probably a minimum of \$5,000 each for two bridges or routers (or routing bridges) from such companies as Microcom or Network Systems. This type of connection can give you a reliable link at speeds up to 1.544 Mbps (megabits per second). The monthly charges depend on the speed of the service and on the types of cable your local carrier has in the ground. Also, though the chances are slim, you should check with the local television cable company to see whether they can provide two-way data service.

As an alternative to cable, you can set up your own radio link between the LANs. The most impressive system I've seen for this purpose is easySPAN, marketed by Armatek (214-437-5833). The easySPAN radio link works with any combination of network operating system and adapter cards.

The easySPAN system consists of a small box about the size of a modem, with a stubby little antenna and a couple of coaxial cable connectors. You'll need one of these \$2,500 radio transceivers on each end of the link. (You can create a multi-point link if you want.) The box connects to an ARCnet adapter of your choice that sits as a separate dedicated adapter inside

the server. You can use multiple LAN adapters with practically any modern network operating system. The ARCnet adapter forms an electrically separate network feeding the easySPAN radio transceiver.

The transceivers operate in the range of 902 MHz to 928 MHz, just above the cellular radio frequencies. They can pen-

*If you need to link
PCs to an IBM
mainframe or mid-level
computer like the AS/400,
that's certainly a
justification for
installing Token-Ring.*

etrate foliage and some types of building materials, and they are very low-power so you don't need a license to install them. With a data rate of 2.5 Mbps, you should get good throughput between network segments.

Token-Ring vs. 10BaseT

One of my clients is thinking of purchasing a large quantity of IBM Token-Ring Network Adapter II boards and associated MAUs (Multistation Access Units). Because of the cost, I've recommended they consider 10BaseT instead; I've installed several hundred 10BaseT nodes with excellent results. Here's my argument: If my client buys 4-Mbps (megabit per second) Token-Ring adapters now and wants to upgrade to 16-Mbps adapters later, they'll have to replace the boards and MAUs. Why not save on the start-up costs? The upgrade costs will be the same in either case.

David C. Adler
via CompuServe

► **PC MAGAZINE** If your client needs to link PCs to an IBM mainframe or mid-level computer like the AS/400, that's a justification for installing Token-Ring. The downside to Token-Ring is the cost of adapters and the wiring. Even the

4-Mbps adapters cost twice as much as a good 10-Mbps 10BaseT adapter. ("10BaseT" refers to an Ethernet LAN running over unshielded twisted-pair, or UTP, wiring.) The shielded twisted-pair (STP) wiring of Token-Ring quickly fills conduits and always requires a special installation program.

On the positive side, STP works at 100 Mbps and more, so it will not soon become obsolete. If you use STP for the 4-Mbps Token-Ring wiring, you won't have to touch the wiring or the MAUs (wiring centers) to upgrade to 16-Mbps service.

On the other hand, using UTP wire for Token-Ring is more problematic. The entire installation must be carefully done and you'll run into significant limitations on the distance of the wiring spans and the number of nodes. Standards are emerging for 16-Mbps Token-Ring over UTP, so your client would probably have to change the UTP MAUs to move up to 16-Mbps service at a later time.

But don't be so sure that your client will need to upgrade to 16-Mbps service anytime soon: 4-Mbps Token-Ring gives almost everyone all the throughput needed for PC-based applications. The most common use of 16-Mbps Token-Ring is to link wiring hubs and wiring closets.

The bottom line? If your client understands the costs, 4-Mbps Token-Ring over STP is an excellent alternative. I would argue against making the investment in Token-Ring running over UTP at this time. □

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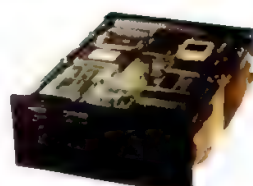
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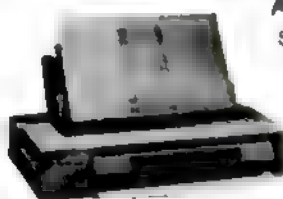
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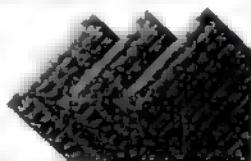
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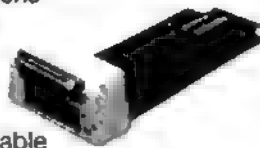
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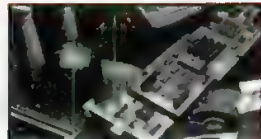
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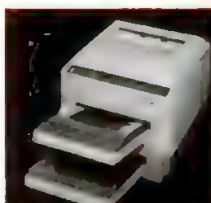
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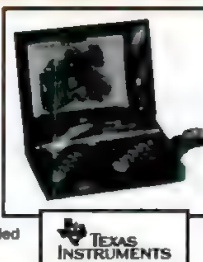
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Longlife 486	4MB MC	\$109.00	286/50	4MB	\$149.00
Longlife 486	4MB MC	154.00	286/50	4MB	219.00
Longlife 486	4MB MC	214.00	286/50	4MB	279.00
Longlife 486	4MB MC	274.00	286/50	4MB	339.00
Longlife 486	4MB MC	334.00	286/50	4MB	399.00
Longlife 486	4MB MC	394.00	286/50	4MB	459.00
Longlife 486	4MB MC	454.00	286/50	4MB	519.00
Longlife 486	4MB MC	514.00	286/50	4MB	579.00
Longlife 486	4MB MC	574.00	286/50	4MB	639.00
Longlife 486	4MB MC	634.00	286/50	4MB	699.00
Longlife 486	4MB MC	694.00	286/50	4MB	759.00
Longlife 486	4MB MC	754.00	286/50	4MB	819.00
Longlife 486	4MB MC	814.00	286/50	4MB	879.00
Longlife 486	4MB MC	874.00	286/50	4MB	939.00
Longlife 486	4MB MC	934.00	286/50	4MB	999.00
Longlife 486	4MB MC	994.00	286/50	4MB	1059.00
Longlife 486	4MB MC	1054.00	286/50	4MB	1119.00
Longlife 486	4MB MC	1114.00	286/50	4MB	1179.00
Longlife 486	4MB MC	1174.00	286/50	4MB	1239.00
Longlife 486	4MB MC	1234.00	286/50	4MB	1299.00
Longlife 486	4MB MC	1294.00	286/50	4MB	1359.00
Longlife 486	4MB MC	1354.00	286/50	4MB	1419.00
Longlife 486	4MB MC	1414.00	286/50	4MB	1479.00
Longlife 486	4MB MC	1474.00	286/50	4MB	1539.00
Longlife 486	4MB MC	1534.00	286/50	4MB	1599.00
Longlife 486	4MB MC	1594.00	286/50	4MB	1659.00
Longlife 486	4MB MC	1654.00	286/50	4MB	1719.00
Longlife 486	4MB MC	1714.00	286/50	4MB	1779.00
Longlife 486	4MB MC	1774.00	286/50	4MB	1839.00
Longlife 486	4MB MC	1834.00	286/50	4MB	1899.00
Longlife 486	4MB MC	1894.00	286/50	4MB	1959.00
Longlife 486	4MB MC	1954.00	286/50	4MB	2019.00
Longlife 486	4MB MC	2014.00	286/50	4MB	2079.00
Longlife 486	4MB MC	2074.00	286/50	4MB	2139.00
Longlife 486	4MB MC	2134.00	286/50	4MB	2199.00
Longlife 486	4MB MC	2194.00	286/50	4MB	2259.00
Longlife 486	4MB MC	2254.00	286/50	4MB	2319.00
Longlife 486	4MB MC	2314.00	286/50	4MB	2379.00
Longlife 486	4MB MC	2374.00	286/50	4MB	2439.00
Longlife 486	4MB MC	2434.00	286/50	4MB	2499.00
Longlife 486	4MB MC	2494.00	286/50	4MB	2559.00
Longlife 486	4MB MC	2554.00	286/50	4MB	2619.00
Longlife 486	4MB MC	2614.00	286/50	4MB	2679.00
Longlife 486	4MB MC	2674.00	286/50	4MB	2739.00
Longlife 486	4MB MC	2734.00	286/50	4MB	2799.00
Longlife 486	4MB MC	2794.00	286/50	4MB	2859.00
Longlife 486	4MB MC	2854.00	286/50	4MB	2919.00
Longlife 486	4MB MC	2914.00	286/50	4MB	2979.00
Longlife 486	4MB MC	2974.00	286/50	4MB	3039.00
Longlife 486	4MB MC	3034.00	286/50	4MB	3099.00
Longlife 486	4MB MC	3094.00	286/50	4MB	3159.00
Longlife 486	4MB MC	3154.00	286/50	4MB	3219.00
Longlife 486	4MB MC	3214.00	286/50	4MB	3279.00
Longlife 486	4MB MC	3274.00	286/50	4MB	3339.00
Longlife 486	4MB MC	3334.00	286/50	4MB	3399.

COMPAQ	Memory Added	Price	AST	Memory Added	Price
DP 386	2MB MC	\$114.00	Arava 486 2	1MB x 1	114.00
13.44" 5.33" S				8MB x 1	144.00
System	4MB MC	114.00	Prism 386 386 2	4MB x 1	114.00
DP 386	1MB MC	114.00		4MB x 1	114.00
200 20.4" 5.33" S	4MB MC	114.00	Prism 486 2	4MB x 1	114.00
	1MB MC	114.00	386 2	4MB x 1	114.00
	2MB MC	114.00	486 2	4MB x 1	114.00
DP 386	4MB MC	114.00	486 2	4MB x 1	114.00
S 16	1MB MC	114.00	486 2	4MB x 1	114.00
	2MB MC	114.00	486 2	4MB x 1	114.00
	4MB MC	114.00	486 2	4MB x 1	114.00
DP 386	1MB MC	114.00	486 2	4MB x 1	114.00
S 16	2MB MC	114.00	486 2	4MB x 1	114.00
	4MB MC	114.00	486 2	4MB x 1	114.00
DP 386	1MB MC	114.00	486 2	4MB x 1	114.00
S 16	2MB MC	114.00	486 2	4MB x 1	114.00
	4MB MC	114.00	486 2	4MB x 1	114.00

Works w/ Model	Memory Added	Price
SEZ 555x1 Ext. 1 P.C.	1MB	\$60.00
555x1 555x1 555x1	2MB	100.00
555x1 555x1 555x1	4MB	140.00
555x1 555x1 555x1	6MB	180.00
555x1 555x1 555x1	8MB	220.00
555x1 555x1 555x1	10MB	260.00
555x1 555x1 555x1	12MB	300.00
555x1 555x1 555x1	14MB	340.00
555x1 555x1 555x1	16MB	380.00
555x1 555x1 555x1	18MB	420.00
555x1 555x1 555x1	20MB	460.00
555x1 555x1 555x1	22MB	500.00
555x1 555x1 555x1	24MB	540.00
555x1 555x1 555x1	26MB	580.00
555x1 555x1 555x1	28MB	620.00
555x1 555x1 555x1	30MB	660.00
555x1 555x1 555x1	32MB	700.00
555x1 555x1 555x1	34MB	740.00
555x1 555x1 555x1	36MB	780.00
555x1 555x1 555x1	38MB	820.00
555x1 555x1 555x1	40MB	860.00
555x1 555x1 555x1	42MB	900.00
555x1 555x1 555x1	44MB	940.00
555x1 555x1 555x1	46MB	980.00
555x1 555x1 555x1	48MB	1020.00
555x1 555x1 555x1	50MB	1060.00
555x1 555x1 555x1	52MB	1100.00
555x1 555x1 555x1	54MB	1140.00
555x1 555x1 555x1	56MB	1180.00
555x1 555x1 555x1	58MB	1220.00
555x1 555x1 555x1	60MB	1260.00
555x1 555x1 555x1	62MB	1300.00
555x1 555x1 555x1	64MB	1340.00
555x1 555x1 555x1	66MB	1380.00
555x1 555x1 555x1	68MB	1420.00
555x1 555x1 555x1	70MB	1460.00
555x1 555x1 555x1	72MB	1500.00
555x1 555x1 555x1	74MB	1540.00
555x1 555x1 555x1	76MB	1580.00
555x1 555x1 555x1	78MB	1620.00
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555x1 555x1 555x1	82MB	1700.00
555x1 555x1 555x1	84MB	1740.00
555x1 555x1 555x1	86MB	1780.00
555x1 555x1 555x1	88MB	1820.00
555x1 555x1 555x1	90MB	1860.00
555x1 555x1 555x1	92MB	1900.00
555x1 555x1 555x1	94MB	1940.00
555x1 555x1 555x1	96MB	1980.00
555x1 555x1 555x1	98MB	2020.00
555x1 555x1 555x1	100MB	2060.00
555x1 555x1 555x1	102MB	2100.00
555x1 555x1 555x1	104MB	2140.00
555x1 555x1 555x1	106MB	2180.00
555x1 555x1 555x1	108MB	2220.00
555x1 555x1 555x1	110MB	2260.00
555x1 555x1 555x1	112MB	2300.00
555x1 555x1 555x1	114MB	2340.00
555x1 555x1 555x1	116MB	2380.00
555x1 555x1 555x1	118MB	2420.00
555x1 555x1 555x1	120MB	2460.00
555x1 555x1 555x1	122MB	2500.00
555x1 555x1 555x1	124MB	2540.00
555x1 555x1 555x1	126MB	2580.00
555x1 555x1 555x1	128MB	2620.00
555x1 555x1 555x1	130MB	2660.00
555x1 555x1 555x1	132MB	2700.00
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555x1 555x1 555x1	138MB	2820.00
555x1 555x1 555x1	140MB	2860.00
555x1 555x1 555x1	142MB	2900.00
555x1 555x1 555x1	144MB	2940.00
555x1 555x1 555x1	146MB	2980.00
555x1 555x1 555x1	148MB	3020.00
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	3 MB Module	89.00
OK Laser 400	2MB Module	119.00
	2MB Module	129.00
	4MB Module	199.00
Panasonic 4450	4MB Module	119.00
Panasonic 4420	4450	
	2MB Module	119.00
	4MB Module	199.00
Panasonic 4455	2MB Module	119.00
Epson EP-600C	4MB Module	207.00
	4MB Module	207.00
Epson Action Laser	2MB Module	149.00
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25x18-20	4.00	25x18-20	3.50
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How PC Direct Helps Insight With its Zero-Defect Goal

"Our goal is zero-defect, and it seems within reach," says Eric Crown, CEO of Insight. "We've made enormous improvements in the way we build and test systems and drives, and it's paid off. We've had entire days when not a single service call was related to a quality control problem."

"One of the keys to achieving zero-defect was to get our sales volume up. That allows us to use

the highest quality components in the business. It also allows us to invest in the best quality control systems."

Insight is attracting a bigger and bigger share of the direct market, and that kind of growth can be achieved in only one place—PC Magazine.

"We believe in PC Magazine's PC Direct section," says Valerie Paxton, Insight's Vice President of Marketing.

"The results of our advertising in PC Direct have been so terrific—today a salesperson told me he had 22 straight phone calls from PC Magazine readers—that we decided to increase our advertising presence in every issue from three pages to eight! The impact on sales of all our products—systems, software and Hard Drives International's mass storage products—has been phenomenal.

"PC Direct buyers can find our ads easily. And we know that because these are PC Magazine readers, they are smart buyers whose companies depend on them to specify brands of PC products, over and over again. In other words, these are customers who are going to be very valuable to us in the long term.

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"We wanted to give buyers a place where they could choose from a broad selection of leading national brands and still get all the advantages of buying from a first-rate direct marketer.

"For example, when a buyer calls us about laptops, we can offer him thirty different choices. And he can discuss the standard and optional

Gordon Hoffstein,
co-founder, PCs Compleat

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features offered by each manufacturer with a technically sophisticated salesperson who has all the facts. We do custom configurations and load applications software. We'll install DOS or Windows, perform a complete system test, and ship the product out the same day it's ordered. And we provide toll-free lifetime technical support."

Hoffstein considers PCs Compleat a breakthrough concept in computer retailing. "When you have an idea this good, you don't want to be shy about it. That's why one of my first marketing decisions was to put a spread ad in every issue of PC Magazine, using the PC Direct section. And it's turned out to be our best lead generator by far."

The PC Magazine reader is Hoffstein's ideal customer.

"Not only does PC Magazine bring us a lot of customers, it brings us the kind of customers we want, those who know that value means more than just a low price.

"Because PC Magazine readers are knowledgeable about the products and features they want, they know what questions to ask our salespeople and they're ready to buy on the first call. They're also more interested in adding options like memory upgrades and fully-loaded software. And they can communicate with our technical support people in an efficient way."

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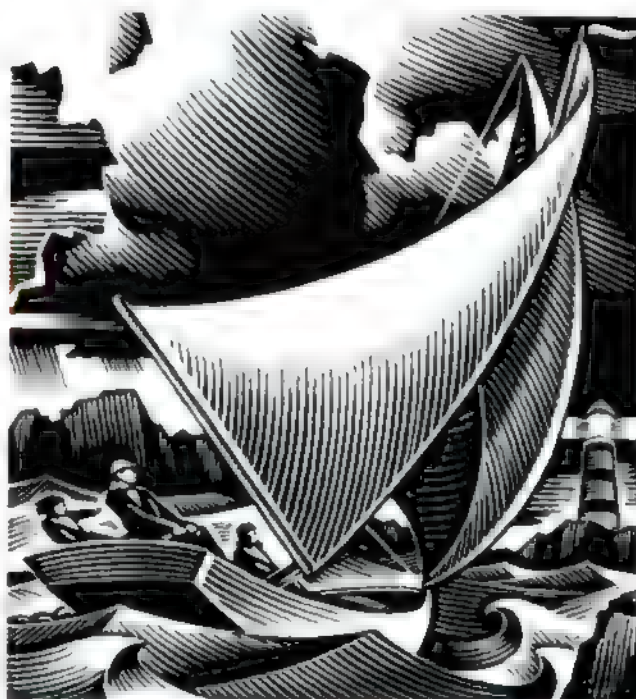
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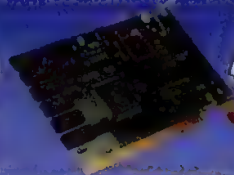
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Accounting		550	557	Manufacturing			561	Diskette Copy Services		556	
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				Project Management				Supplies		556	563
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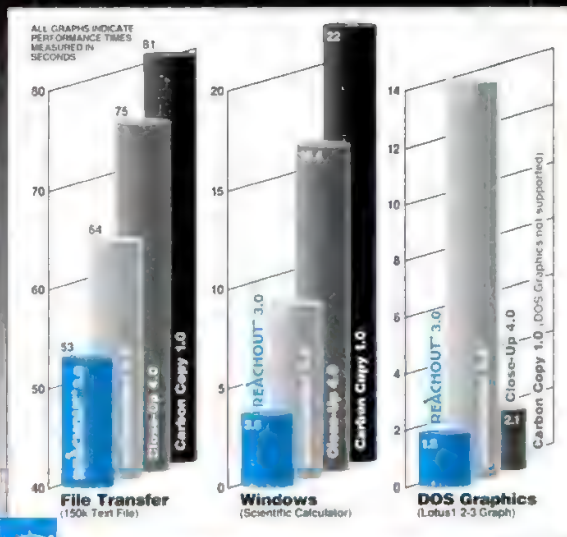
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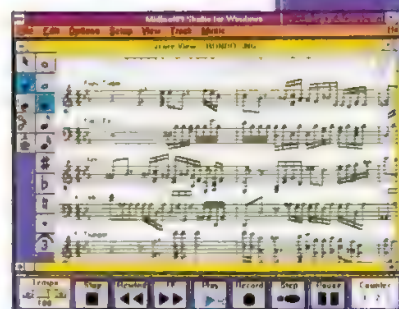
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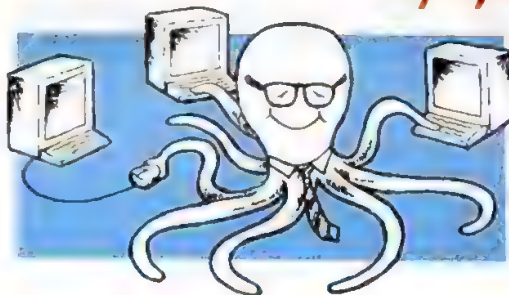
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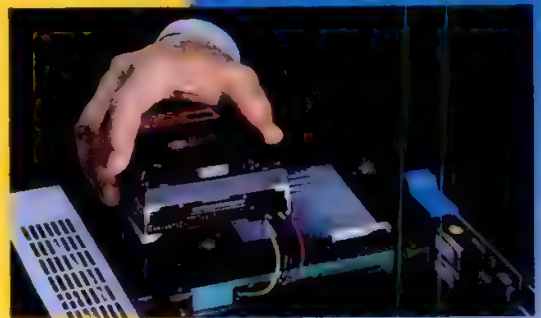
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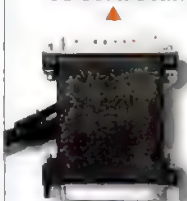
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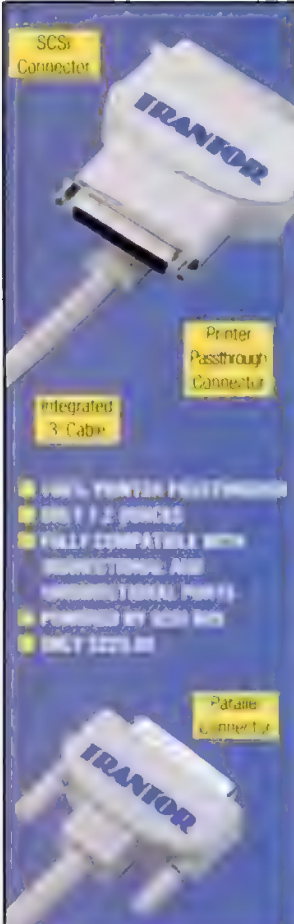
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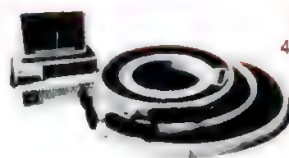
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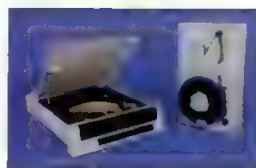
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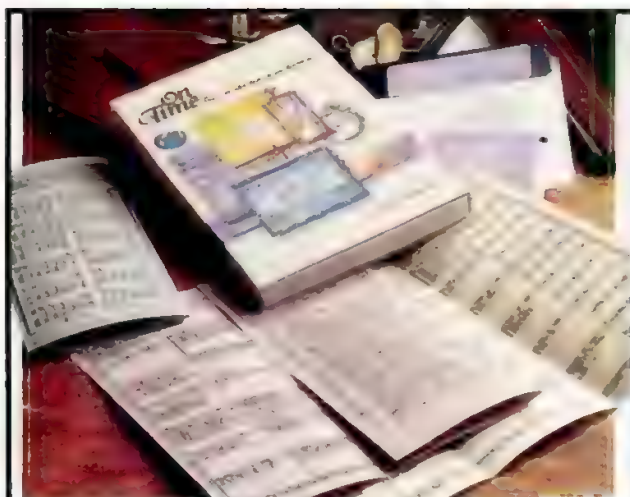
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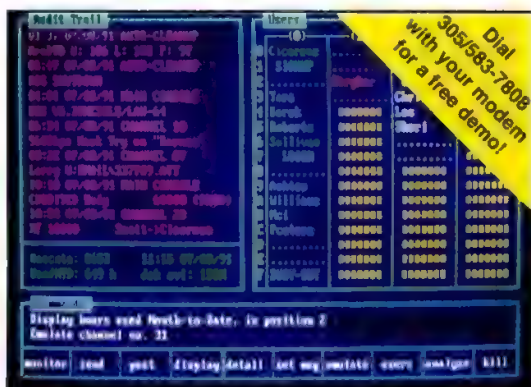
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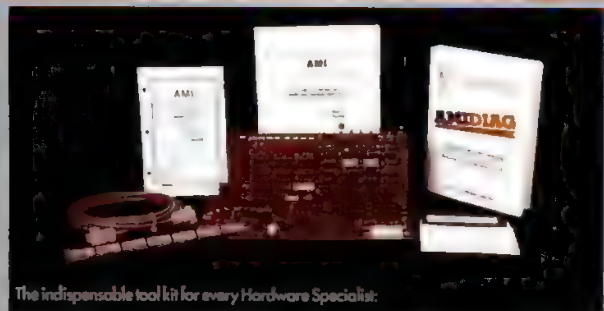
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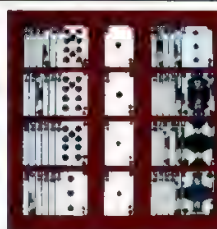
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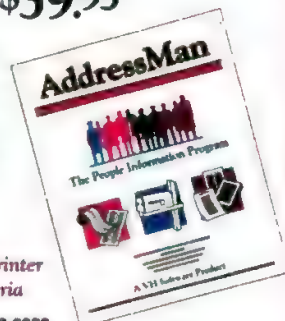
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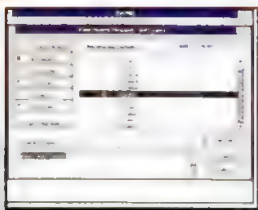
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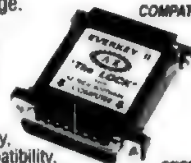
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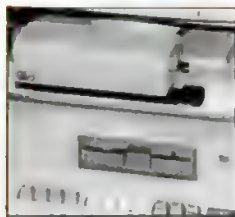
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2. Please indicate your company or organization's primary business activity: (Check one only)

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- 03. ☐ Manufacturer—Other
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- 06. ☐ Computer Retailer/VAR/VAD Distributor
- 07. ☐ Communications
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- 10. ☐ Government—Federal
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- 07. ☐ Computer Consulting
- 08. ☐ Purchasing
- 09. ☐ Operations
- 10. ☐ Production
- 11. ☐ Education/Training
- 12. ☐ Marketing/Sales
- 13. ☐ Medical/Legal
- 14. ☐ Admin./Mgmt.
- 99. ☐ Other

4. Is your company a reseller?

01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

- 01. ☐ 10 or less 03. ☐ 26-99
- 02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

(Check all that apply.)

- 01. ☐ Linked to mainframe
- 02. ☐ Linked to mini
- 03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)

- 01. ☐ IBM or Compatible PCs
- 02. ☐ IBM or Compatible Mainframes
- 03. ☐ IBM or Compatible Minis
- 04. ☐ Macintosh
- 05. ☐ CD-ROM
- 06. ☐ Windows

8. Do you plan to buy any PC Products?

- 01. ☐ Now
- 02. ☐ In 4 to 6 months
- 03. ☐ In 7 to 12 months
- 04. ☐ No definite plans

9. Number of Employees in your entire company:

- 01. ☐ 25 or less
- 02. ☐ 26-99
- 03. ☐ 100-499
- 04. ☐ 500-999
- 05. ☐ 1000 or more

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1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116
1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163
1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200										

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Coming Up

Windows Desktops

With the emergence of Windows 3.1, Microsoft has taken a step toward a more intuitive desktop environment. Yet judging from the number of desktop replacements and enhancers on the market, there's still a distance to go. Next issue, *PC Magazine* takes a look at some of the best (and worst) among these contenders for the desktop throne.

SQL Front Ends

Now that you've chosen which Structured Query Language server best suits your company's needs, we'll introduce you to SQL front ends that can put a pretty but powerful face on your DBMS. Our technology overview will look at the query, analysis, and development tools available for SQL and highlight some of the more interesting products we've seen.

True-Color Artistry

With Photo CD, better scanners, and true-image clip art, 24-bit image editors will play an increasingly vital role in manipulating, processing, and customizing images. Professional artists and casual users can now work with 16.7 million colors in an easy-to-use, responsive environment. *PC Magazine* tests eight packages to see which offers the best combination of features, ease of use, and quality output.

Surge Suppressors

The fanciest computer in the world won't do you much good if you can't protect it from electrical surges. *PC Magazine* examines some of the controversies abounding in the equipment-protection industry, exposing some well-worn myths on the way. We also round up 30 surge suppressors at Ziff-Davis Labs, separating the safe from the shockingly bad.

VGA to NTSC Cards

Your computer can achieve new compatibility with your VCR or television with a little help from a VGA-to-NTSC card. Now you can videotape your computer-based presentations, create special titling effects, or overlay computer graphics atop video images—or, with an NTSC-to-VGA card, route the picture from your TV screen to your VGA monitor.

Utilities

TOPPER, next issue's utility, is a small Windows 3.1 program that lets you "float" an application—even an icon—above your currently active full-screen program. Just click on the TOPPER icon and select Top or Bottom, and you can float or sink any window with a click of the mouse without deactivating the program window in which you're working.

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After Hours

RAILROADING: Maxis's *A-Train* and Abracadata's *Design Your Own Railroad*
SCIENCE: *Science Adventure* **GAMES:** *EcoQuest*, *Sherlock*

RAILROADING

Build an Empire—or Just a Track With Two Railroad Simulations

BY JOE SALEMI

Many train addicts play Maxis's *SimCity* just to run the game's railroad network and see the effect of an all-rail simulation on population and development. Others, intent on building an empire, swear by the cutthroat competition of *Railroad Tycoon*, from Microprose. Now these hobbyists have two new game-playing and track-laying alternatives. *A-Train*, Maxis's latest simulation, combines the empire-building mentality of *Railroad Tycoon* with the city planning and development of *SimCity*. *Design Your Own Railroad*, from Abracadata, allows you to plan your live model railroad in much the same way that *Design Your Own Home*, the company's do-it-yourself CAD package, lets you plan your new home.

A-TRAIN

Maxis's *A-Train* is an American adaptation of *Take the A-Train III*, from Artdink, a Japanese company. (The previous version, *A-Train II*, was released in the U.S. by Seika Corp. as *Railroad Empire*.) *A-Train* begins by offering you a choice of six predefined scenarios, ranging in size from a small rural area to the heart of a downtown metropolis. Each scenario comes equipped with at least one rail line that brings

construction materials and passengers into the district the scenario covers.

To succeed in the game, you have to build additional rail lines to encourage development in outlying areas, or make sure that the existing rail lines run at a profit. Both tasks require judicious scheduling and expansion.

You start out with a sum of money (the amount differs with each scenario) that can be used to lay track, buy trains, and build stations. You're not just building a railroad, though. You're managing the development of a city. You can purchase real estate and use it to store materials, or you can sell it off later at a profit. You can build a number of commercial enterprises around the stations in order to encourage development and growth.

A-Train lets you build apartment houses for your citizens to live in and factories, office buildings, and shopping malls to employ them. As the town grows, you can provide your town with recreational facilities including ski resorts, amusement parks, and golf courses. You can even build hotels for tourists. Of course, you

have to make sure your city has the traffic to support these businesses.

The simulation itself also provides some growth, as other citizens build houses and other companies build commercial properties around your station.

You win the game if you're able to sustain the type of growth you want for the area while maintaining a steady cash flow. You lose if you go bankrupt. Every property you own generates a profit or loss, and different trains have different operating characteristics and expenses.

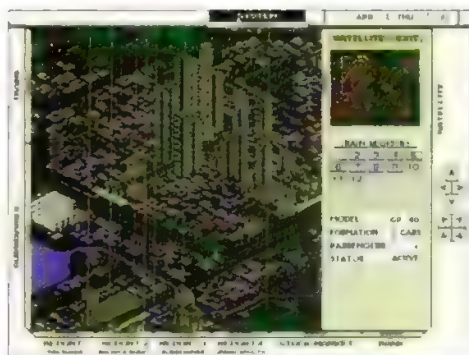
As is true in many of Maxis's simulations, monitor-

ing your resources quickly becomes a full-time job. Four real-time reports help you keep your eye on different aspects of the railroad's financial status. If cash gets tight, you can apply for one- to three-year loans at the bank to tide you over. If you're cash-rich, you might want to invest in other companies through the stock market.

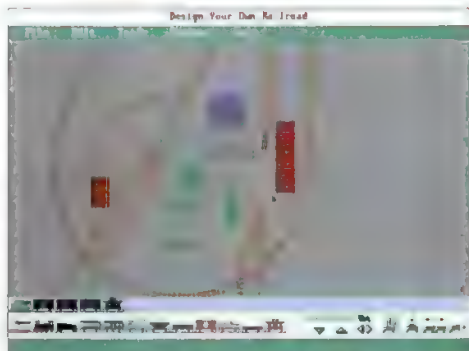
A-Train maintains Maxis's reputation for high-quality graphics and sound. The simulation runs on a 24-hour day (the speed is user-adjustable) and is based on a calendar year. You can watch your trains pull into and out of the stations as the lighting changes

from day to night and the seasons cycle around. As each night comes, the buildings light up; as summer changes to winter, the leaves change color and fall off the trees and the ground becomes white with a freshly fallen snow. Other details also mark the passing of the year, such as flocks of migrating birds flying overhead in April and October. Santa Claus even visits the town on Christmas Eve.

Maxis's *A-Train* fills the middle ground between *SimCity* and *Railroad Tycoon*. This simulation will appeal to railroad lovers who want to spend their time running trains and building up cities instead of fighting off angry citizens or cutthroat competition.



A-Train's Satellite view lets you move quickly around the district map and monitor your trains as nighttime descends on your city.



You can add scenery to Design Your Own Railroad's layout, and you can test-run trains on your design to get a feel for how it works.

Railroading

A-Train, \$69.95. Requires: 640K RAM, DOS 3.1 or later; mouse recommended. Maxis, 2 Theater Sq., #230, Orinda, CA 94563-3346; 510-254-9700; fax, 510-253-3736.

Circle 519 on reader service card

DESIGN YOUR OWN RAILROAD

Trial-and-error construction is hardly the best way to build a railroad, whether the line spans the country or merely fills your den. Abracadata, maker of the Design Your Own Home series of simple CAD (computer-aided design) programs, has come to model railroaders' rescue with Design Your Own Railroad, Version 1.2.

DYORR is a simplified CAD program that lets you design railroad layouts in any shape, in sizes that range from 4 to 9,999 feet wide. You can test run your trains before you lay the first piece of track.

The program comes with default settings for a number of model railroad scales (the size of the models in relation to the real thing, ranging from the briefcase-size Z to the garden-size G). Design Your Own Railroad lets you set a number of other factors that control the layout's size, including total working space and the minimum radius on curves. Once you've set up the basic shape, you're ready to draw.

Laying track is as simple as placing the cursor at the start point and dragging it to the end point. Curved track automatically follows the minimum radius you established, and turnouts are placed where three tracks join. A handy on-screen scale ruler helps you determine how long sections of the track are, and a drawing grid that makes it easier to keep things straight can be

toggled on and off. You can do all your designing with the keyboard, but a mouse makes the job much easier. DYORR has variable zoom capabilities, so you can focus on a particular portion of the layout or zoom out so you can see the whole thing.

Once you've got the track laid out to your liking, you can use the program's drawing objects to represent scenery on the layout. These objects give you an idea of where your industries and stations fit best. DYORR includes support for a variety of laser and dot-matrix graphics printers, so you can make a working printout of your track plan when you're done.

You can use just about any general CAD program to design a track. Abracadata, however, lets you run trains on

your track design. You can create a number of freight or passenger trains with a variety of cars pulled by diesel or steam engines, and run the trains over the on-screen layout. You can track the train over turnouts, through yards, and around stations or factories, and get a feel for how your trains will run on the actual model. If you don't have the space or budget for a real model railroad, DYORR can give you the opportunity to design and run the layout you have always wanted.

The operations mode also gives DYORR some gaming capabilities. You can set up factories and stations as places to pick up or drop off cargo and passengers. An operations clock adjusts real-world time to model time, and lets you race against the clock to

complete switching maneuvers or freight moves in time. While not as complex as Microprose's Railroad Tycoon or Maxis's A-Train, the operations mode of DYORR is a fun way to spend a few hours running trains.

Model railroaders will find DYORR an indispensable part of their modeling toolkits. Armchair modelers can use DYORR to run trains while they plan for the day when they can build a real layout.

Design Your Own Railroad, Version 1.2, \$59.95; Optional library of 12 layouts, \$29.95. Requires: 512K RAM, DOS 2.0 or later; mouse recommended. Abracadata, P.O. Box 2440, Eugene, OR 97402, 503-342-3030; fax, 503-683-1925.

Circle 520 on reader service card

SCIENCE

Learn About Life with Asimov's Science Adventure

BY ROBERT ANTHONY

Is it educational software or is it just good, mind-stimulating entertainment? That's left for you to decide in Science Adventure, the third multimedia software package from Knowledge Adventure.

Through the pen of noted author Isaac Asimov (who died earlier this year), Science Adventure covers a wide range of topics in mathematics, physics, chemistry, life, technology, earth and ecology, and space with an engaging combination of text, images and sound. By using compressed image files that are decompressed only as they are needed, Science Adventure provides an entertaining multimedia soft-

ware package that doesn't require CD-ROM technology but still doesn't compromise on the image quality.

Science Adventure improves on the software engine used by its two predecessors, Knowledge Adventure and Sports Adventure. The program's high-resolution, 256-color VGA images look even cleaner than the ones in the

previous packages. Even the mouse pointer looks like a real hand with the index finger extended. You can zoom in on some images so they fill the screen, and you can search through Science Adventure's library by typing out words or phrases. You can also enlarge the interactive globe, which shows you where a product was invented or an event occurred.

Like the two earlier packages, Science Adventure is easy to navigate. To explore a new category, just click on one of the seven subject icons at the top of the screen. You can travel through time, from 5 million B.C. to the present, by sliding the bar from left to right along the time line at the bottom of the screen. Al-



Science Adventure allows you to research subjects such as this 1908 Ford car assembly line by clicking on different parts of the screen.

most any move you make calls up a new subject.

As is the case with Knowledge Adventure's first two packages, Science Adventure uses hyperlinks to take you on your journey from one subject to the next. Different parts of each picture are linked with others on related topics. You can click on each different element in that picture, in the same manner that you would use hypertext, and learn about those subjects. You're never sure where in time or space you'll end up.

If you click your mouse on the tire of a car, for instance, you zip to a picture and story of the invention of vulcanized rubber by Charles Goodyear. Aim at the car's hood, and you bring up a file on the gasoline engine. If you click on the realistic ear icon (complete with earring) the car's engine revs up. Occasionally, you may click on a part of the screen and wind up with a seemingly unrelated subject, but getting back to the previous image is as easy as clicking on the U-Turn icon.

There's no right way to use Science Adventure. Your curiosity is your guide. New 256-color versions of Knowledge Adventure and Sports Adventure are planned for the near future.

Science Adventure, \$79.95. Requires: 500K RAM, 8MB hard disk space, DOS 2.1 or later; mouse recommended. Supports Ad Lib Gold Card, Covox Speech Thing, Disney Sound Source, Sound Blaster, and ThunderBoard sound cards. Knowledge Adventure Inc., 4502 Dyer St., La Crescenta, CA 91214; 800-542-4240, 818-542-4200; fax, 818-542-4205.

Circle 521 on reader service card

GAMES

EcoQuest: Kids Rescue the Whales While They Save the World

BY DANIEL A. BEGUN

If you've ever had a desire to explore the oceans, save the world, or just play Doctor Doolittle and talk to the animals, here's your chance to do it all. With Sierra On-Line's latest children's educational software offering, EcoQuest: The Search for Cetus, you team up with the talking cousin of Flipper and help save the world from oil spills, toxic wastes, and other underwater hazards. The game combines the fun of a graphics adventure game with environmental education.

In EcoQuest, you are Adam, a 12-year-old boy who befriends a talking dolphin named Delphineus. You and Delphineus return to Eluria, the dolphin's home world, and attempt to save it from ecological destruction. Once you've stabilized Eluria's environment, you must find the source of the toxicity that threatens that world. You must then locate the missing whale-king, Cetus, upon whom the balance of Eluria's fragile ecosystem depends.

SOME HUMOR

Along the way you must gain the trust of the human-wary citizens of Eluria. Among the characters you meet are Erro-neous, a well-read Anglophilic sea turtle, and Narcissus, a pretentious French blowfish. The game has a sense of humor; whether it's a great sense of humor is debatable.

EcoQuest's digital music and sound effects are out of this world. The music successfully adds to the dramatic feel of the game. A musical score reminiscent of a Kitaro recording captures the eeriness of being underwater. The game's hi-resolution, 256-color VGA graphics give EcoQuest's underwater scenes a realistic feel. These hand-painted three-dimensional graphics are intensely colored and enjoyable to watch.

Although younger children

4463) for an on-line hint; all you need is a modem. Sierra also has a 24-hour hint line, but the charges for the 900-number call start at 75 cents for the first minute.

INFORMATION RICH

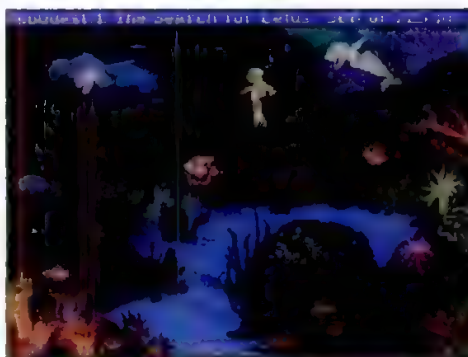
EcoQuest is structured to make young people more interested in learning about the ecological concerns of the ocean—perhaps even to seek some of this knowledge on their own. EcoQuest makes it convenient enough to get the information; resources are blatantly sprinkled throughout the game. EcoQuest even comes with a book that helps children develop some of these values: *I Helped Save the Earth: 55 Fun Ways Kids Can Make a World of Difference*. Some of these hints are even used in the game itself.

The Search for Cetus is the first in a series of EcoQuest games; Sierra On-Line has other ecological adventures in store for Adam. The game also comes with its own environmentally correct newsletter, "Adam's Eco-News," printed on recycled paper. So put on your fins, strap on your tank, and get ready to save the planet.

EcoQuest: The Search for Cetus, \$59.95.

Requires: 640K RAM, 5MB hard disk space, DOS 3.3 or later. Sierra On-Line Inc., P.O. Box 485, Coarsegold, CA 93614; 209-683-4468; fax, 209-683-3633.

Circle 522 on reader service card



EcoQuest's underwater world offers Adam and Delphineus much to explore during their search for Cetus, the whale king.

will need assistance from an adult, EcoQuest never forgets that its audience starts at age 10. For example, Adam can't die; the game simply won't allow it. If you don't figure out a puzzle quickly enough, the program takes over and completes the task for you.

Only a few of the problems are very difficult. In one, you must slide a series of tiles to unscramble a mosaic in the Temple of Poseidon; in a second puzzle, you need to rescue a glowing fish from inside an underwater artifact. If you're stumped, you can call the Sierra Bulletin Board (209-683-

SHAREWARE

Sherlock Logic Game Challenges Your Deductive Powers

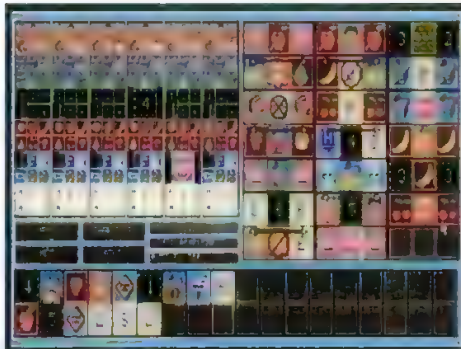
BY NEIL J. RUBENKING

When you have eliminated the impossible, whatever remains, however improbable, must be the truth."

Remember this quote from the great Sherlock Holmes as you play Sherlock, a graphical, mouse-driven logic game for EGA or VGA display. Sherlock is played on a field of six rows and six columns, with each row containing six related images. Up to 39 clues provide just enough information about the *relationship* between the images that you can deduce their correct locations.

Clues across the bottom of the screen show pairs of images that are or are not in the same column. The clues at the right of the playing area tell you that two or three images are or are not in immediately adjacent columns, that one image is or is not directly between two others, or that one image is somewhere to the left of another.

To win, you must eliminate the impossible and work with what remains. If the numeral 3 is to the left of 2, for instance, the 3 can't be on the extreme left, nor the 2 on the extreme right, of the playing area.



Use the clues underneath and to the right of Sherlock's playing field to fill the board's 36 spaces with the correct images.

Stymied? Click on the Hint button and Sherlock will make one play for you and explain the reasoning behind it. Each hint costs 30 seconds of game time, but when you're learning the game the hints are extremely helpful.

Deducing the correct solution is satisfying, but doing it quickly is better. By default,

Sherlock times each game, and an optional countdown timer forces you to solve the game within a fixed time period. Players can also compete to see who can solve a puzzle fastest.

Sherlock is addictive, and at 5 to 10 minutes a game, it's perfect for relaxing between projects. Besides, you can't beat the \$15 shareware price. You can download an evaluation copy of Sherlock, with its 65,536 puzzles, from PC MagNet's After Hours forum, Library 3. □

Sherlock, \$15 shareware registration. Requires: 512K RAM, DOS 3.0, mouse. Everett Kaser Software, 35405 Spruce St. SW, Albany, OR 97321; 503-928-5259.

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Bill Howard

WordStar for DOS 7.0 now shipping in Canada

WordStar International Inc. has announced shipments of WordStar for DOS, version 7.0, a significantly upgraded version of the company's flagship word processor.

The new release features a new SAA/CUA compliant user interface that includes pull-down menus and redesigned dialogue boxes. Other features include a "record and play" memo system, fax and mouse support, and enhanced

The new interface gives users the option of using the classic WordStar interface or using the improved SAA/CUA menus and dialogue boxes. The new interface shares significant interface design with WordStar for Windows, and includes a title bar, scroll bar, menu bar, style bar, ruler line and status line. Mouse support is now available throughout the core WordStar program, including Advanced

actions, and plus complete system debugging utilities.

Users can copy and from the Windows when running WordStar. WordStar also converts ASCII format as the Clipboard.

WordStar Canada

DOS 7 already?

With all the white space at the end of the line, BUSINESS COMPUTER NEWS (March 20, 1992) could have used the word processor's full name: WordStar for DOS, Version 7.0.

Amazing Facts

"The other advance in [Windows] 3.1 most people will appreciate is the improved reliability. That is, you're less likely to see the error message 'UAE' (Unexplained Application Error) on screen because the word processor or spreadsheet you're using in Windows has just died."

—SAN JOSE MERCURY NEWS, APRIL 19, 1992

"Advanced Micro's DXL chip features a sleep mode, which allows it to reduce power consumption when the computer is turned off."

—COMPUTER SOURCES, JULY 1991

"ROM is Read Only Memory. It contains instructions that hang around to be read whether or not there's electricity."

—Desktop Computing supplement in NAVY TIMES, ARMY TIMES, AND AIR FORCE TIMES, MARCH 23, 1992

"[The virus] Michelangelo has no effect on mainframe or big computers which run the MS DOS microsoft disk operating system."

—THE COURIER TIMES, BUCKS COUNTY, PENNSYLVANIA, MARCH 1, 1992

Winner, Semiannual DAK Thunder Lizard Award For Advertising Hyperbole

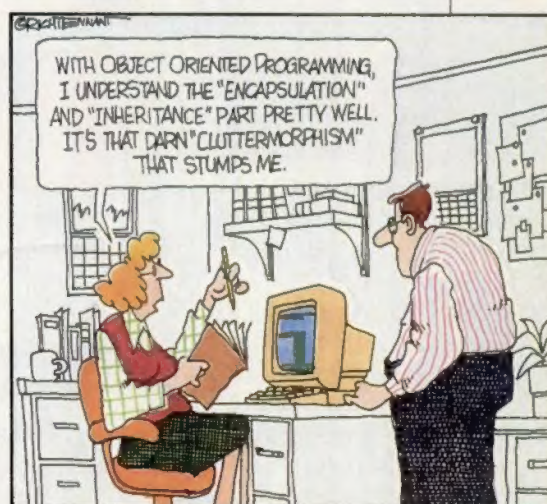
To the Circuit City electronics

chain, for its breathless description of the AST 386SX PC: "Complete 386SX System. Get lots of power, plus great Microsoft software for your most demanding office or home projects! You've also got ample room to expand, plus the capability to customize for specific applications. A 2400 baud modem and Prodigy are your links to a vast network of information. VGA video

circuitry also gives you eye-popping graphics! An amazing 145 watts of power supplies the system. Complete with 2MB RAM and 80 MB hard drive."

—LOS ANGELES TIMES, APRIL 26, 1992

It's been a while since we heard a 145-watt power supply called "amazing."



If your entry is used in Abort, Retry, Fail? we'll send you \$50 and a PC Magazine T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of each entry are considered. Winners this issue: Jean-Marc Lacroix (DOS 7.0), Guillermo L. Payet (Unexplained Application Error), David Pipe (sleep mode), Joseph Niemi (ROM with or without electricity), Gerard Kunkel (Michelangelo), Douglas S. Hyman (Circuit City).

LAW.

MURPHY'S LAW #43

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